KING COUNTY RENEWABLE ELECTRICITY TRANSITION PATHWAYS

Prepared for King County

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CADMUS

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Goal. King County has adopted a goal of supplying 90% of county-wide electricity needs for all residents and businesses with renewable electricity resources by 2030. This report documents the results of a project supporting the County in developing potential strategies to meet that target. The 90% renewable electricity goal is the result of the 2015 Strategic Climate Action Plan (SCAP), in which King County and its municipal partners in the King County-Cities Climate Collaboration (K4C) have set greenhouse gas emissions reduction targets of 50% by 2030 and 80% by 2050 against a 2007 baseline. The County has identified this 90% county-wide renewable electricity goal was as one of several priority areas (also including transportation and building energy use and transportation fuel mix) to address in making progress on its broader emissions targets.

Current Power Mix. In 2016, renewable electricity resources supplied 67% of the electricity used county-wide. Overall, hydroelectricity is the dominant resource in King County, meeting just over 50% of the county's electricity needs. The two major electric utilities that serve the county presently have substantially different power mixes. Seattle City Light (SCL), a municipal utility that functions as a department of the City of Seattle, sources more than 90% of its power from renewable resources, while Puget Sound Energy (PSE), an investor-owned utility that serves most of the area around Seattle, receives roughly 40% of its power from renewable electricity resources and roughly 60% from coal and natural gas. King County's current power mix is deeply connected to the region's historical policy and regulatory context, through which Seattle City Light has access to plentiful and long-developed hydroelectric resources and Puget Sound Energy has under the regulation of the Washington Utilities and Transportation Commission pursued a least-cost procurement that has resulted in power mix made up primarily of coal, hydroelectricity, and natural gas.

Purpose and scope of analysis. This analysis aims to identify pathways to achieving the county's 90% by 2030 renewable electricity target, and to understand the projected impacts of each of the pathways in terms of energy supply, energy cost, and non-energy impacts. To achieve these goals, a Project Team led by the Cadmus Group worked with King County staff and key stakeholders through the following major steps:

- Stakeholder engagement. Cadmus and King County convened a half-day facilitated workshop (as well as targeted follow-up interviews) of key stakeholders to solicit views on the county's potential pathways for renewable electricity transitions, and key policy options of interest.
- Barriers and opportunities research and analysis. Informed by stakeholder feedback, the Project Team researched and analyzed a set of 39 potential policy options (strategies) to determine feasibility for implementation in King County.
- Scenario identification and impact assessment. Cadmus and King County identified a series of policy scenarios based on this assessment, and the Project Team modeled the potential impact of these policy scenarios on the county-wide power mix compared to a baseline scenario.

Scenario Definition. Cadmus evaluated the impacts of four strategy scenarios:

1. Emphasis on local policy action, which includes enacting a county-wide net zero energy policy, developing a local incentive program for solar generation, and prioritizing electricity generation in biogas production. Under this scenario, the rate of distributed generation would increase substantially, but impacts on the county-wide power mix would be relatively small.
2. Emphasis on voluntary action by utility customers, which centers on partnerships with local utilities (through on-bill financing or repayment programs and increased participation in utility-sponsored renewable electricity purchasing programs). This scenario would seek to maximize county-utility collaboration, but its impact would be limited by the willingness of county utility residents and businesses to voluntarily participate in renewable energy programs.
3. Carbon pricing policy. This scenario considered the impacts of a state policy that targeted decarbonization of the existing power supply, which was assumed in this analysis to take the form of a price on carbon. This approach is expected to accelerate the market-driven decline of coal in the region by 2030, and to result in a dramatic investment in new renewable electricity resources in the coming decades that replaces fossil-fuel generated electricity.
4. Enact a 100% Renewable New Generation policy. This state-level policy would require that all new generation be developed from renewable resources. This approach is projected to have only limited impacts by 2030, as few new non-renewable natural gas resources are planned in this period, but to have deeper impacts in the long-term.

Key Findings. The projected impacts of these scenarios on county-wide power mixes are described below.

Table 1. Percentage of County-Wide Renewable Electricity Projected by Scenario

<table>
<tr><th colspan="2">Scenario</th><th>SCL</th><th>PSE</th><th>King County</th></tr>
<tr><td colspan="2">2016 Power Mix</td><td>94%</td><td>44%</td><td>67%</td></tr>
<tr><td colspan="2">2030 Business as Usual Baseline</td><td>93%</td><td>55%</td><td>72%</td></tr>
<tr><td rowspan="5">2030 – Policy Scenarios</td><td>Emphasize Local Actions</td><td>93%</td><td>61%</td><td>75%</td></tr>
<tr><td>Emphasize Voluntary Actions</td><td>97%</td><td>66%</td><td>80%</td></tr>
<tr><td>Carbon Pricing Policy</td><td>94%</td><td>69%</td><td>80%</td></tr>
<tr><td>100% Renewable New Generation</td><td>93%</td><td>57%</td><td>73%</td></tr>
<tr><td>All Policies Combined</td><td>99%</td><td>85%</td><td>91%</td></tr>
</table>

Under no single strategy is King County's power mix expected to reach the target of 90%; however, if all strategies are deployed concurrently, the 90% target may be achieved. It is expected that, for King County to meet its renewable electricity targets, it must simultaneously act to expand distributed generation within the county, partner with utilities to expand pathways for voluntary renewable energy purchasing, and work with state policy-makers to take broader steps to decarbonize the state power supply. Further, meeting the County's target is expected to require action to increase renewable electricity resources in each utility's power mix.

1. INTRODUCTION AND BACKGROUND

1.1 PRIOR WORK AND OBJECTIVE

Many of King County's energy and climate goals and programs are structured through the King County-Cities Climate Collaboration (K4C), a collaboration between the County and thirteen municipal governments that represent over 75% of the county's population. Together with local government partners, the County has developed ambitious targets for greenhouse gas reduction and increased renewable electricity supply.

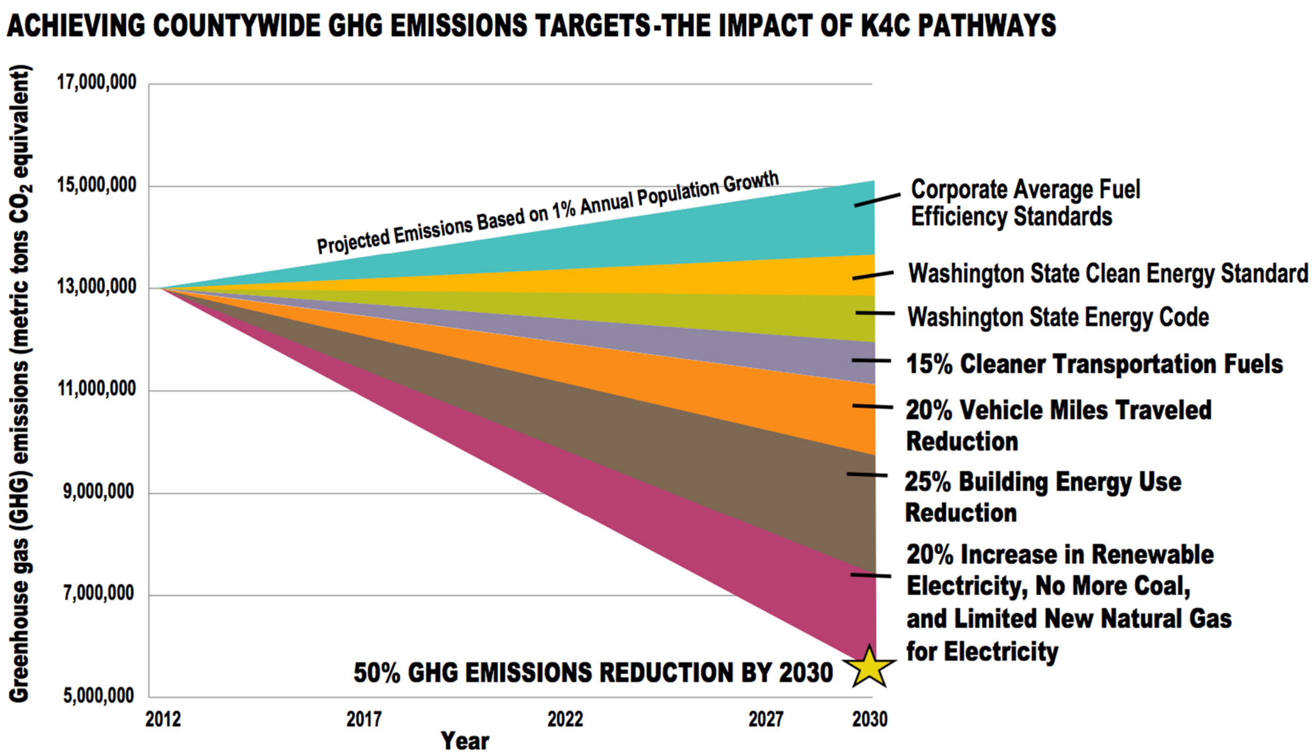
In 2014, elected leaders of the county and K4C cities signed a joint letter committing to a set of climate actions[1] in King County that targeted a county-wide reduction in greenhouse gas (GHG) emissions (against a 2007 baseline) of 25% by 2020, 50% by 2030, and 80% by 2050. These commitments also called for an increase in the use of renewable electricity of 20% over 2012 levels by 2030, which would achieve a renewable electricity mix of 90% by 2030.

In 2015, the County released a Strategic Climate Action Plan (SCAP),[2] which included an analysis by K4C and Climate Solutions' New Energy Cities Program that evaluated the types of emissions reductions necessary for the County to meet its 2030 GHG targets. The resulting wedge analysis, shown in Figure 1, shows that King County must achieve marked progress on transportation, building efficiency, and electricity supply by 2030 to meet these targets.

[1] Available at: https://your.kingcounty.gov/dnrp/library/dnrp-directors-office/climate/2016-K4C-LetterOfCommitments.pdf

[2] Available at: https://your.kingcounty.gov/dnrp/climate/documents/2015_King_County_SCAP-Full_Plan.pdf

Figure 1. King County Target GHG Emissions Reductions through 2030 (from King County 2015 SCAP).



This project focuses on the last wedge in the above graphic – that of electricity supply. This analysis explores potential pathways to reaching 90% renewable electricity county-wide.[3]

King County assembled a Project Team to:

1. Identify policies, programs, and strategies that King County can pursue, either independently or in collaboration with key stakeholders, to make progress towards its target of 90% renewable electricity county-wide by 2030.
2. Understand the projected impacts of different policy and program options, in terms of the impact on energy supply, energy costs, and non-energy impacts.

The Project Team for this effort was led by the Cadmus Group, a sustainability consulting firm with national and international experience developing and implementing policies and programs promoting clean energy market development. Cadmus was supported by Spark Northwest, a Seattle-based non-profit organization with experience in local and state clean energy markets and policy, and by International Energy Transition GmbH, a Germany-based firm with international experience in grid decarbonization strategies.

[3] The analysis attempts to narrowly target the renewable electricity supply, but does incorporate projected impacts from vehicle electrification. As seen in Figure 2, King County has goals for the development of alternative fuels, single-passenger vehicles and transit fleet vehicles, with the acknowledgement that transportation electrification will increase load. Increased electricity demand creates even greater urgency to develop additional renewable electricity resources.

The Cadmus Project Team worked with King County staff and key stakeholders on the following project elements:

3. Clarifying and Defining Goals. Cadmus convened a small working group of County and K4C representatives to discuss the key parameters of the project. This included a discussion of how the County's 90% renewable electricity goal would be defined for the purposes of this analysis.
4. Development of Initial Set of Policies and Strategies. Drawing on its *Pathways to 100* policy primer,[4] Cadmus developed an initial set of roughly 20 potential program and policy options for discussion and refinement with the K4C project team and key stakeholders.
5. Stakeholder workshop and engagement. The Project Team convened a half-day workshop with 19 stakeholders representing state and local government, electric utilities, and private sector and non-profit organizations. The workshop solicited stakeholder feedback both on general principles to follow in targeting an increase in King County's renewable electricity penetration and on specific programs and policies that could be used to pursue the County's targets. The Project Team also conducted follow-up interviews with a range of stakeholders to further understand the range of perspectives represented and to request additional information.
6. Barriers and Opportunities Analysis. Based on stakeholder feedback received, the Project Team expanded its list of programs and policies of interest to 39 entries, and conducted research on the feasibility, barriers, opportunities, and potential impacts of these policies in King County.
7. Scenario Identification. Following this analysis, Cadmus and the K4C project team developed four distinct packages of policy options that reflected different strategies that the County could adopt in the pursuit of its 90% renewable electricity target.
8. Power Mix Scenario Modeling. Finally, Cadmus developed a power mix model which projected the amount of renewable electricity penetration in King County's under three sets of baseline assumptions and in each of the four policy scenarios determined in the above steps. In addition to the impact of these policy options on the county's power mix, Cadmus assessed the costs and the non-energy impacts of different policy packages.

1.2 DEFINITION OF RENEWABLE ELECTRICITY

To successfully track progress against King County's 90% renewable electricity target, a clear definition of renewable electricity is necessary. There are multiple possible definitions of renewable electricity, and the specific definition used will have implications for the types of strategies and policies that are useful in making progress towards the County's goal. Some of the key dimensions in defining eligible renewable electricity sources include:

- Determination of Eligible Power Sources. The Washington State Renewable Portfolio Standard (RPS) considers the following resources to be renewable: wind, solar, geothermal, landfill gas, water,

[4] Available at: https://cadmusgroup.com/papers-reports/pathways-to-100-an-energy-supply-transformation-primer-for-u-s-cities/

wave, ocean or tidal power, gas from sewage treatment plants and biodiesel fuel and biomass. The state places significant eligibility restrictions on the use of hydroelectric power, a major source of electricity generation in Washington State, for RPS compliance. Hydroelectric resources must have been developed after 1999 to be eligible in the RPS,[5] excluding much of the state's hydroelectric portfolio. Eligibility limitations based on the construction age of renewable electricity generating plants are common in state RPS policies nationwide, as these policies are designed with the goal of encouraging the development of new resources.

- Inclusion of Renewable Energy Certificates (RECs) and voluntary purchases. A REC is "a market-based instrument that represents the property rights to the environmental, social and other non-power attributes of renewable electricity generation."[6] REC purchases are often made alongside purchases of non-renewable grid electricity to permit claims on renewable energy ownership. RECs are purchased by utilities as a means of complying with state renewable portfolio standards, and are also purchased on a voluntary basis by individual residents or businesses that wish to make renewable energy claims, often coordinated through a utility green power purchasing program. Some local jurisdictions consider RECs purchases to be helpful components of a renewable energy portfolio because of the flexibility that they afford.
- Regional production of Renewable Electricity. Some local jurisdictions may express a preference for local or regional sources of power. While the location of renewable electricity projects does not change the global climate impacts of electricity generation, this can impact the extent that the local community shares in other types of benefits associated with renewable generation (such as economic benefits and health impacts). The Washington State RPS, for example, requires eligible resources to be based in the Pacific Northwest or delivered to Washington on a real-time basis. [7]

The Project Team discussed these potential approaches to defining renewable electricity with King County and K4C staff, and developed the following definition of renewable energy to be used in this analysis:

- All the renewable electricity resources listed in the Washington State RPS are considered renewable, with no limitations based on the construction year of generating facilities (therefore, all existing hydroelectric resources are considered to contribute towards meeting the County's 90% target).
- Progress towards 90% renewable electricity will be determined based on the mix of delivered power among the county's utilities, as determined by utility-owned generation and power contracts, and the power mix of the regional grid. Unbundled REC purchases made by utilities for the purposes of RPS compliance will not be counted towards this goal, as the County preferred an approach that would result in the development of local and regional renewable electricity projects that would provide delivered energy to the county. This modeling decision includes SCL's current practice of

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[5] Washington State Department of Commerce. Energy Independence Act (EIA or I-937). 2017. http://www.commerce.wa.gov/growing-the-economy/energy/energy-independence-act/

[6] United States Environmental Protection Agency. Green Power Markets. Renewable Energy Certificates (RECs). 2017. https://www.epa.gov/greenpower/renewable-energy-certificates-recs

[7] Washington State Department of Commerce. Energy Independence Act (EIA or I-937). 2017. http://www.commerce.wa.gov/growing-the-economy/energy/energy-independence-act/

purchasing carbon offsets for the small non-renewable portion of its power mix. However, voluntary renewable electricity purchases made by King County residents and businesses are considered to count towards the county's renewable electricity levels. In this analysis, only voluntary renewable energy purchases coordinated through utility programs are included, as independent programs may not source power from local or regional sources.

Only renewable electricity projects located in the Northwest (Washington, Oregon, Idaho, Montana) are considered as contributing to King County's renewable electricity goal. As all utility generation sources and REC sources in utility programs are already located in the Northwest, this does not create any additional constraints on the definition of renewable electricity in addition to those discussed above.

1.3 ORGANIZATION OF THIS REPORT

The remainder of this report is organized in the following sections:

- Section 2 provides an overview of King County's current electricity mix. This chapter focuses on identifying the key drivers behind the amount of renewable electricity currently delivered to King County, and on identifying and illustrating differences between the county's two major utilities.
- Section 3 presents baseline projections of King County's power mix through 2030 in the absence of coordinated County policy action.
- Section 4 explores the policy scenarios that were developed by the Project Team, and presents the results of the policy scenario modeling analysis.
- Section 5 summarizes the impacts of a broad set of County policy strategies, touching on power mix, cost, economic development, and equity impacts.
- Section 6 provides a concluding discussion of the preceding analysis, and highlights conclusions for King County policymakers and stakeholders.

In addition, this report includes the following appendices:

- Appendix A discusses the barriers and opportunities analysis conducted to identify key strategies available to the County in pursuing higher levels of renewable electricity, which informed the policy scenarios selected for modeling in Section 4.
- Appendix B provides detail on modeling methodology and data sources used to conduct the scenario modeling exercise discussed in Sections 3 and 4.

2. CURRENT KING COUNTY ELECTRICITY LANDSCAPE

2.1 UTILITY BACKGROUND

State Regulatory Context: The regulatory oversight of utilities in Washington State is largely a function of their ownership structure. Investor-owned utilities (IOUs) are regulated by the Washington Utilities and Transportation Commission (UTC), and public utilities (which may either be organized as a division of municipal government or as a separate public utility district) are governed either by a separately elected board or the municipal council. State regulation of IOUs is used to determine retail electricity prices that are just, fair, reasonable, and sufficient (RCW 80.28.010), and to ensure that customer demands are met with a "least cost mix of energy supply resources and conservation" (WAC 480-100-238).

Washington State has a Renewable Portfolio Standard (RPS) established by the Energy Independence Act (EIA), which was approved by voters in a state-wide election in 2006. Under the EIA, all utilities serving at least 25,000 customers must pursue all cost-effective conservation measures and procure renewable energy supplies as a percentage of customer load. The portfolio targets increase over time, from 3% in 2012, to 9% in 2016, to 15% in 2020 and beyond.

Washington State does not place a tax on carbon emissions. Legislative efforts to establish a carbon tax have failed in recent sessions, and an initiative on the ballot did not pass in 2016.

King County is primarily served by two electric utilities – Seattle City Light (SCL) and Puget Sound Energy (PSE).[8]

Seattle City Light is a municipal utility that functions as part of the Seattle city government. SCL's service territory includes all of Seattle and portions of the communities of Burien, Tukwila, SeaTac, Shoreline, Lake Forest Park, Renton, and unincorporated King County.[9] In 2016, SCL delivered roughly 9,700 GWh to customers, all of which was delivered within King County.[10]

Puget Sound Energy is an investor-owned utility (IOU) serving electricity and natural gas to a 10-county area in western Washington. In 2016, PSE delivered 21,500 GWh to retail electricity customers throughout

[8] Small amounts of retail electricity in the county are provided by Snohomish Public Utility District and Tanner Electric Cooperative. These utilities are not included in this analysis as they have a negligible impact on the county's overall electricity mix.

[9] For a description of Seattle City Light's service area, see: http://www.seattle.gov/light/electricservice/map.asp

[10] US Energy Information Administration Form-861 Annual Utility Reporting Database, available at: https://www.eia.gov/electricity/data/eia861/

its service territory.[11] King County accounts for roughly half of PSE's service territory, with 49% of electricity customers and 53% of retail electricity sales based in the county.[12]

Table 2 shows the combined sales of these two utilities both throughout their service territories and within King County. There is a roughly even mix of sales in the county across the two utilities, with PSE providing slightly more than half of the county's electricity needs.

Table 2. 2016 Electricity Delivered within King County.[13]

Utility	2016 Sales in Total Service Territory (GWh)	King County Share of Total Sales	2016 Sales in King County (GWh)	Percent of 2016 King County Electricity Mix
SCL	9,672	100%	9,672	44%
PSE	21,585	53%	11,440	56%

2.2 POWER SOURCES AND POWER MIX

King County's utilities source their power from a combination of: resources that are owned directly by the utility, power that is contracted on a long-term basis from non-utility producers, and power that is purchased on a short-term basis. A small portion of King County's electricity is sourced from customer-owned distributed generation as well.

In determining the sources of power used by the two utilities, the analysis relies primarily on the 2016 Fuel Mix Disclosure reports issued by the Washington State Department of Commerce, which provide detailed information on the mix of energy sources secured by each utility in the state.[14] Information on distributed generation is from the US Energy Information Administration Form-861 Annual Utility Reporting Database.[15]

This report divides the power sources of the two utilities into five primary categories:

- Distributed Generation
- Generation Owned by the Utility or Under Long-Term Contract
- Generation Purchased from the Bonneville Power Administration
- Short-term Market Purchases
- Voluntary Customer Renewable Energy Purchases

[11] US Energy Information Administration Form-861 Annual Utility Reporting Database.
[12] PSE 2017 Integrated Resource Plan, available at: https://pse.com/aboutpse/energysupply/pages/resource-planning.aspx
[13] These figures exclude distributed generation.
[14] Data available at: http://www.commerce.wa.gov/growing-the-economy/energy/fuel-mix-disclosure/
[15] Available at: https://www.eia.gov/electricity/data/eia861/

2.2.1 Power Mix Overview

In 2016, power delivered by utilities to King County was 65% renewable, or 67% including voluntary customer purchases. The power mix of the two major utilities that serve the county are substantially different. SCL sources more than 90% of its power from renewable resources, due to a legacy of utility-owned hydroelectric projects as well as preferential purchasing status from the Bonneville Power Administration, while PSE relies heavily on coal and natural gas and as a result sources just under half of its power from renewable electricity resources. While PSE's present power mix has a lower share of renewable energy than SCL's, PSE has recently announced plans to reduce its carbon footprint 50% by 2040, principally through a combination of coal plant closure, renewable energy development, and transportation electrification.[16]

Overall, hydroelectricity is the dominant resource in King County, addressing over 50% of the county's electricity needs in 2016. Wind energy accounts for most of remaining renewable resource serving the county. The non-renewable resources serving the county are 58% coal, 34% natural gas, and 8% nuclear, with a small amount of other fuels.

Nearly 70% of the county wide electricity supply comes from generation sources either owned or under long term contract by the county's two utilities. The remaining 30% is split between power purchases from the Bonneville Power Administration or from a variety of regional power generators. Only 0.2% of county-wide current electricity needs are met by customer-owned distributed generation. The clear majority (85%) of the non-renewable energy delivered to the county is from utility-owned or contracted resources.

An overview of King County's delivered power mix is provided in Figure 2.

Figure 2. King County 2016 Power Mix by Power Source and Purchase Type.

[16] See PSE carbon plan press release, available at: https://pse.com/aboutpse/PseNewsroom/NewsReleases/Pages/PSE-to-reduce-its-carbon-footprint.aspx

2.2.2 Distributed Generation

Based on data collected by the US Energy Information Administration, an estimated 35 MW of installed distributed generation capacity was active in SCL and PSE service territory in King County in 2016, providing an estimated 40 GWh of electric output per year. Roughly 90% of this generation was from solar energy projects.

In the context of King County's overall electricity needs, the amount of electricity provided by distributed generation is very small, accounting for only 0.2% of the county's electricity needs.

Table 3. 2016 Distributed Generation Installed in King County.[17]

DG Type	SCL MW	PSE MW	Total King County	
			MW	MWh/yr
Solar	14	19	33	35,966
Wind	-	0.1	0.1	280
Hydro	-	0.1	0.1	263
Natural Gas	-	1.8	1.8	3,552

2.2.3 Generation Owned by Utility or Under Long-Term Contract

Nearly 70% of King County's electricity supply (53% for SCL and 81% for PSE) is provided by resources that are either owned by the utility or for which the utility has a long-term power purchase agreement.[18]

The generation profiles of the two utilities are substantially different. SCL's generation portfolio is made up entirely by renewable sources, with the utility's substantial hydroelectric assets accounting for 90% of its owned or contracted generation. Roughly two-thirds of the PSE generation fleet is made up of coal or natural gas, with the remaining third split mostly between hydro and wind.

[17] As county-level data is not available in the sources used in this analysis, PSE's service area-wide distributed generation amount is pro-rated by county-level sales to estimate the amount of DG installed within King County.
[18] All data in this section is sourced from the WA DOC's 2016 Fuel Mix Disclosure Report.

Table 4. 2016 Owned and Long-Term Contracted Generation in King County.

Fuel	SCL		PSE (In-County)	
	GWh	Pct of Total Power Mix	GWh	Pct of Total Power Mix
Hydro	4,642	48%	2,413	21%
Wind	373	4%	1,060	9%
Solar	-	0%	1	0%
Biomass	135	1%	17	0%
Coal	-	0%	3,678	32%
Natural Gas	-	0%	2,164	19%
Oil	-	0%	6	0%
Total	**5,150**	**53%**	**9,339**	**81%**

2.2.4 Bonneville Power Administration Generation

Much of the hydroelectric generation capacity in the Pacific Northwest is owned by the federal government and marketed to regional utilities through the Bonneville Power Administration (BPA). Because municipal utilities (including SCL), public utility districts, and cooperatives are statutorily granted preference over IOUs in the purchase of BPA electricity, this makes up a much greater share of SCL's power mix (44% of power) than PSE's (3%).[19]

BPA power is primarily sourced from hydroelectricity, with most of the remainder from nuclear power. In this analysis (following the WA DOC's Fuel Mix Disclosure reports), the Project Team applied BPA's overall resource blend to these sales to determine the percent of electricity provided from different resource types.

Table 5. 2016 Mix of Power Purchased from Bonneville Power Administration.

Fuel	SCL		PSE (In-County)	
	GWh	Pct of Total Power Mix	GWh	Pct of Total Power Mix
Hydro	3,751	39%	347	3%
Biomass	2	0%	0.2	0%
Natural Gas	0.3	0%	0.03	0%
Nuclear	487	5%	45	0%
Total	**4,241**	**44%**	**392**	**3%**

[19] All data in this section is sourced from the WA DOC's 2016 Fuel Mix Disclosure Report.

2.2.5 Short-Term Market Purchases

In addition to longer-term sources of power supply, both SCL and PSE purchase power on the short-term regional spot market. In 2016, SCL purchased roughly 3% of its power from the short-term market, and PSE purchased roughly 15%. Based on WA DOC's 2016 Fuel Mix Disclosure report, just under half of these spot market purchases are from renewable resources.[20]

Table 6. 2016 Mix of Power Purchased from Northwest Spot Market.

Fuel	SCL		PSE (In-County)	
	GWh	Pct of Total Power Mix	GWh	Pct of Total Power Mix
Hydro	121	1%	735	6%
Biomass	4	0%	25	0%
Coal	93	1%	567	5%
Natural Gas	53	1%	320	3%
Oil	1	0%	8	0%
Nuclear	7	0%	40	0%
Other	2	0%	13	0%
Total	**280**	**3%**	**1,709**	**15%**

2.2.6 Voluntary Customer Renewable Electricity Purchases

Both King County utilities offer mechanisms for customers to voluntarily purchase renewable electricity through utility programs. These include:

- Seattle City Light's Green Up Program, in which customers' electricity purchases are matched with RECs procured from Northwest renewable electricity producers.[21]
- Puget Sound Energy's Green Power and Solar Choice Programs, which also match customer electricity purchases with Northwest RECs. All RECs are sourced from regional solar projects.[22]
- Puget Sound Energy's Green Direct Program, in which the utility facilitates the direct purchase of renewable electricity by customers from specified renewable electricity providers. Only large utility customers and local governments are eligible for this program, and customers are billed under a special tariff.[23]

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[20] To determine the power mix of spot market purchases, WA DOC compiled the resource mix of the Northwest Power Pool as a whole and subtracted any generation owned or contracted bilaterally by a utility, as well as BPA generation. The resulting power mix was applied to all spot market purchases state-wide.

[21] For more information on power sources, see the SCL Green Up Product Content Label, available at: http://www.seattle.gov/light/Greenup/docs/scl-product-content-label.pdf.

[22] For more information on power sources, see the PSE Green Power Program Product Content Label, available at: https://pse.com/savingsandenergycenter/GreenPower/Documents/PIECHART_041117.pdf; and the sources for the PSE Solar Choice program at: https://pse.com/savingsandenergycenter/SolarChoice/Pages/default.aspx.

[23] For more information on Green Direct, see: https://pse.com/aboutpse/Rates/Documents/elec_sch_139.pdf.

King County considers voluntary purchases of Northwest RECs made by King County residents and businesses to count towards its 90% renewable electricity target, but these generation purchases are not included in the utility generation portfolios just described. Therefore, purchases conducted through the SCL Green Up program and the PSE Green Power and Solar Choice programs are considered to be additional to the amount of renewable electricity included in the utility's delivered supply. As the PSE Green Direct program was not announced until 2017, the renewable energy purchased through that program is also not included in the above 2016 baseline and is also treated as additional.

Cadmus estimates that these programs combined amount to the equivalent of 86 GWh/yr of renewable electricity in SCL service territory, and 760 GWh/yr in PSE service territory (a pro-rated 403 GWh/yr of which is assumed to occur within King County).[24]

2.2.7 Resource Mix Summary

Table 7 shows King County's overall fuel mix, separated by utility and resource type, as well as the percentage of each resource type that comes from renewable electricity sources.

Table 7. Overall 2016 King County Electricity Resource Mix.

	GWh Supplied						Percent Renewable		
	SCL		PSE (In County)		King County				
Resource Type	GWh	Pct	GWh	Pct	GWh	Pct	SCL	PSE	King County
Distributed Generation	15	0.2%	25	0.2%	40	0.2%	100%	86%	91%
Owned or Long-Term Contracts	5,150	53%	9,339	81%	14,489	69%	100%	37%	60%
BPA Supply	4,241	44%	392	3%	4,633	22%	88%	88%	88%
Short Term Supply	280	3%	1,709	15%	1,990	9%	44%	44%	44%
Total	**9,687**	**100%**	**11,465**	**100%**	**21,152**	**100%**	**93%**	**40%**	**65%**
Including Impact of Voluntary Customer Renewable Purchases	86	1%	403	4%	489	2%	94%	44%	67%

Overall, King County receives 67% of its power from renewable resources, including voluntary customer purchases. Power delivered by SCL is 93% renewable, while power delivered by PSE is 40% renewable. Three primary factors explain the difference in the mix of resources procured by the two utilities:

1. BPA power, which is nearly 90% renewable, makes up over 40% of SCL's resource mix but only a small share of PSE's.

[24] Detail on sources and methodology for this estimate is provided in Appendix B.

2. Due to SCL's considerable hydroelectric resources, most of its remaining resource needs (after BPA purchases) may be met by utility-owned or contracted renewable resources. PSE has less hydroelectric capacity and uses utility-owned or contracted resources to meet over 80% of its resource needs, which includes a considerable amount of non-renewable energy.

PSE purchases a greater share of its power on the spot market than SCL. The regional spot market has a slightly higher share of renewable electricity than PSE's own resources, but a much lower share than SCL or BPA power. Meeting a 90% county-wide renewable electricity supply, then would require either the development of additional utility-owned renewable resources, a greater share of renewables in the regional spot market, or a combination of the two.

3. BASELINE SCENARIOS

The purpose of the baseline scenarios is to evaluate what the electricity mix is likely to be in 2030 without clear additional policy action. The team developed power mix projections under three baseline scenarios.

The first baseline, a Business-as-Usual (BAU) scenario, maps the trajectory of the county's electricity mix based on planned additions and retirements in Utility Integrated Resource Plans (IRPs). This BAU scenario purposefully makes minimal departures from proposed utility plans, and, where necessary, assumes that additional new supply needs will be met by market purchases.

A second baseline, an Early Colstrip Retirement scenario, assumes an accelerated retirement schedule for the Colstrip Power Plant, a coal facility partly owned by PSE which accounts for roughly 20% of PSE's power supply. PSE's integrated resource plan calls for the retirement of units 1 and 2 of the Colstrip plant in 2022, and of units 3 and 4 in 2035. As this analysis projects the King County power mix through 2030, BAU baseline accounts for the retirement of units 1 and 2, but not units 3 and 4. In a September 2017 settlement, PSE agreed to fully depreciate Colstrip units 3 & 4 by 2027,[25] a move that has been interpreted by environmental groups as indicating that the plant may be retired in that year as well.[26] While the ultimate retirement date of Colstrip units 3 and 4 is still uncertain, the Project Team conducted this second baseline projection assuming the retirement of these units in 2027.

A final baseline, a Worst-Case scenario, uses the BAU baseline as a starting point, but makes several modifications that would broaden the gap between King County's renewable energy share and its 90% by 2030 target. These modifications include:

- Reversing the expected retirements of coal plants that currently provide power to King County.
- Decreasing the amount of hydroelectric generation due to the impacts of climate change.
- Limiting the effectiveness of planned utility energy efficiency programs.
- Assuming a dramatic electrification rate of transportation energy beyond what is assumed in utility IRPs.[27]
- Halting the growth of distributed renewable resources in King County.

As summarized in Table 8, King County's renewable energy power mix is expected to increase from 67% in 2016 to 72% in 2030 under the BAU scenario and 75% in the Early Colstrip Retirement scenario. In the

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[25] Washington Utilities and Transportation Commission, *Partial settlement reached in Puget Sound Energy rate case*, available at: https://www.utc.wa.gov/aboutUs/Lists/News/DispForm.aspx?ID=470.

[26] See, for example, the Sierra Club press release regarding the settlement: https://www.sierraclub.org/press-releases/2017/09/settlement-paves-way-for-western-washington-be-free-coal-power.

[27] Electrification is considered in a "worst case scenario" solely because of the need to secure additional renewable electricity generation to meet a 90% target. Electrification would increase potential for additional carbon emissions reductions, particularly in Seattle City Light territory, where existing renewable electricity commitments are expected to be adequate to serve baseline load forecasts. In other modelling scenarios, future load is based on utility IRPs, and so utility forecasts are implicitly used.

Worst-Case scenario, it is expected to decrease only to 64% by 2030, an indication of the substantial hydroelectric resources under the control of King County's utilities.

Table 8. Summary of Baseline Power Mix Projections

Utility	SCL	PSE	King County
2016 Reference Year	94%	44%	**67%**
2030 Business-As-Usual Baseline	93%	55%	**72%**
2030 Early Colstrip Retirement Baseline	93%	60%	**75%**
2030 Worst-Case Baseline	89%	45%	**64%**

Of these scenarios, the business-as-usual scenario is assumed to be the most likely and is used as the baseline in the determination of policy impacts. The additional baseline scenarios are provided to demonstrate a potential range in King County's future power mix, in the absence of further policy action.

3.1 BUSINESS AS USUAL (BAU)

Several factors are expected to impact King County's electricity mix by 2030, even in a BAU scenario. The most impactful are several plant retirements and new generation resources called for in PSE's IRP. PSE plans to retire units 1 and 2 of the Colstrip power plant in 2022, and to entirely close the Transalta Centralia coal plant in 2025. These plant retirements, which are indicated by the noticeable bumps in Figure 3 below, would reduce the share of coal power in PSE's power mix from 37% to 22%, and would lower the overall share of coal in King County's grid from 21% to 13%.

The decline in coal generation is projected to be made up for by a combination of natural gas and new renewables. Planned generation additions in PSE's IRP will address part of the resulting decline in power supply, which calls for 486 MW in new solar capacity and 1,195 MW of new peaking thermal energy (primarily natural gas) by 2037. As these new resources would produce only a quarter of the electricity of the retired plants, it is expected that PSE would increase its market purchases to make up for the net loss in utility-controlled generation. Without securing other sources of generation, the share of electricity that PSE obtains from the market would increase from 15% to 33%. As discussed in Section 2 above, the regional short-term market is currently made up primarily of hydro (43%), coal (33%), and natural gas (19%), which the Project Team holds constant for the duration of the study period in the absence of broader state policy action.[28] In contrast to PSE, SCL does not project any plant closures or new generation by 2030 in its IRP,

[28] The regional mix of short-term power supply may also be impacted by PSE's participation in the California Independent System Operator's Energy Imbalance Market (EIM). The EIM is a mechanism for PSE and other participating utilities and grid balancing authorities to coordinate real-time shortages and surpluses in energy supply. Potential implications of PSE's participation of the EIM on the utility's short-term power mix are not considered here.

and so its power mix is projected to stay constant in the BAU forecast, with the exception of slightly increased market purchases as a result of demand growth.

Beyond planned changes to generation, both utilities project slight increases in annual electricity sales in their IRPs (roughly 0.2% per year for SCL, and 0.4% per year for PSE), which in the absence of new generation is expected to be met primarily by short-term market purchases.

In the BAU scenario, distributed generation is expected to increase over time. Extrapolating King County's current rate of distributed generation installation through 2030, distributed generation (primarily solar) would account for 0.7% of King County's electricity needs by 2030. While this is more than a three-fold increase over 2016 levels, the overall penetration rate is quite low and distributed electricity is not anticipated to be a significant factor in King County's electricity mix in the BAU scenario. Voluntary customer purchases are also expected to increase slightly, reflecting the current growth rate in utility green pricing programs and the assumed full subscription of the PSE Green Direct program.

Due to the replacement of retired coal generation with market purchase and the additional market changes described above, the share of PSE's power mix from renewable resources (including voluntary purchases) is expected to increase from 44% to 55%. SCL's renewable electricity mix is projected to decrease slightly in this scenario, due to increased market purchases as customer sales increase, though this is a largely negligible impact.

Overall, in the BAU scenario, King County's renewable power mix is expected to increase from 67% to 72% in 2030, a modest increase that achieves roughly 15% of the impact needed to meet King County's target of 90% renewable electricity penetration.

The results of this scenario are shown below.

Figure 3. King County Projected Power Mix by Year; Business-As-Usual Baseline

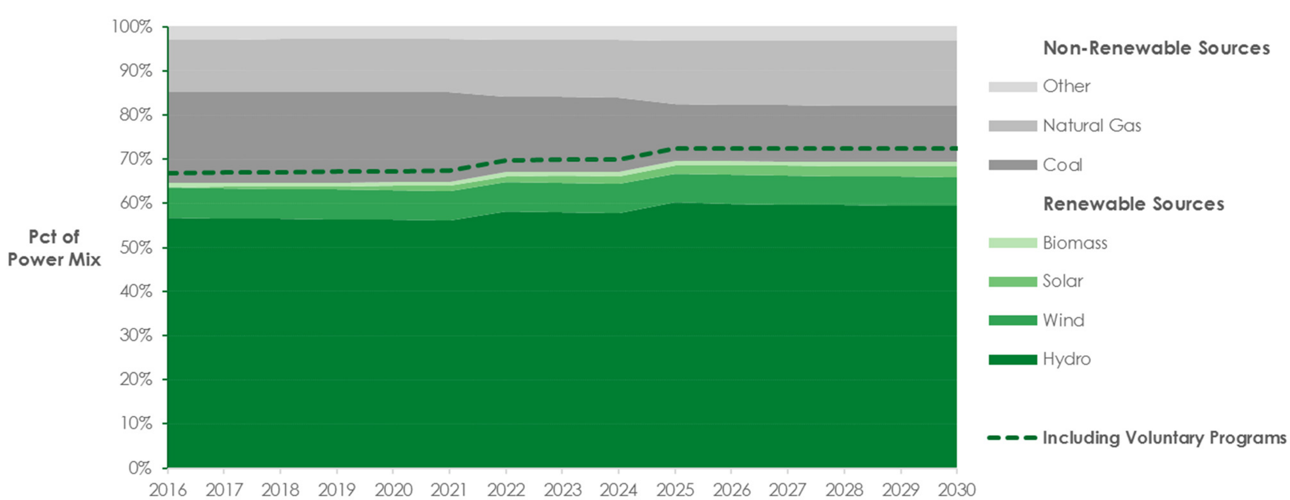

Table 9. Percentage Renewable Electricity Projected; Business-As-Usual Baseline

Utility	Delivered Utility Power Only		With Voluntary Purchases	
	2016 Baseline	2030 Baseline	2016 Baseline	2030 Baseline
SCL	93%	92%	94%	93%
PSE	40%	51%	44%	55%
King County	**65%**	**69%**	**67%**	**72%**

3.2 EARLY COLSTRIP RETIREMENT

The early closure of Colstrip units 3 and 4 in 2027 would have the result of further shifting PSE's generation portfolio from utility-controlled assets and towards market purchases (though this analysis does not consider the potential for PSE to pursue the construction of new generation facilities not presently called for in its IRP to make up for the shortfall in generation rather than increasing market purchases). This would further reduce the share of coal generation in PSE service territory to 15% in 2030, and in King County's grid to 9%.

The additional closure of Colstrip units 3 and 4 during the study period would increase the share of King County power from renewable resources to 75%.

Figure 4. King County Projected Power Mix by Year; Early Colstrip Retirement Baseline

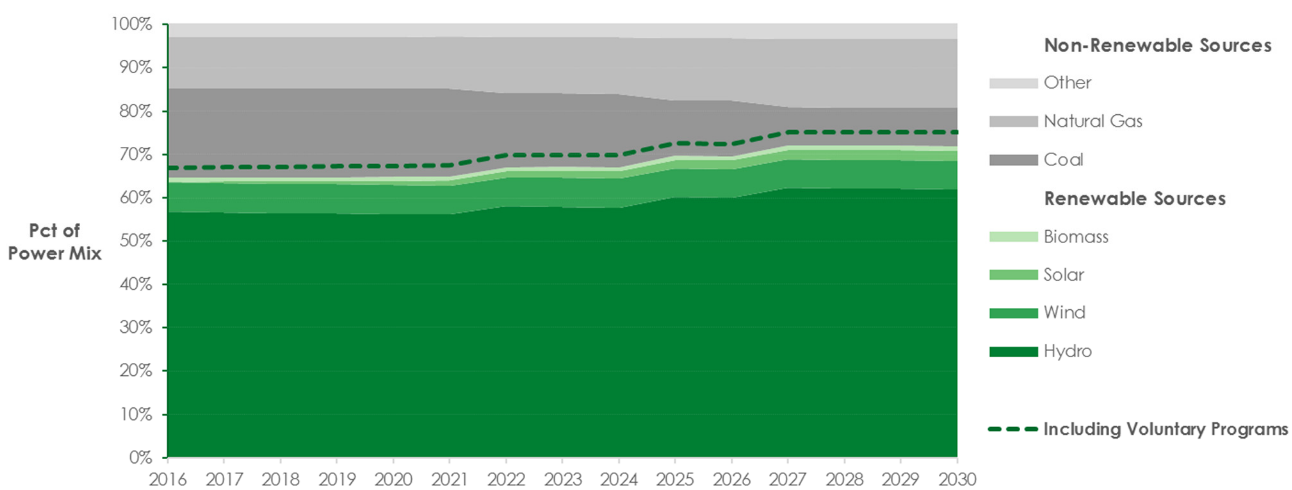

Table 10. Percentage Renewable Electricity Projected; Early Colstrip Retirement Baseline

Utility	Delivered Utility Power Only		With Voluntary Purchases	
	2016 Baseline	2030 Baseline	2016 Baseline	2030 Baseline
SCL	93%	92%	94%	93%
PSE	40%	55%	44%	60%
King County	**65%**	**72%**	**67%**	**75%**

3.3 WORST-CASE SCENARIO

In the worst-case scenario, the overall King County renewable power mix is projected to decline from 67% (including voluntary purchases) to 64%. There are several contributing factors to this:

- Without the expected closure of the Colstrip and Transalta plants, PSE's projected renewable mix would remain constant at 40%. As these closures create opportunities for increased market purchases of renewable electricity in the BAU scenario, reversing these, either by extending the life of Colstrip or converting Transalta to a natural-gas fired facility would lead to a substantial lost opportunity for renewable electricity gains.
- By assuming a loss in new energy efficiency opportunities as well an increase in load due to transportation electrification, the utilities' expected annual load growth would increase to 0.5% for SCL and 1.4% for PSE. In the absence of new generation sources, utilities increase their market purchases, which have a lower share of renewable energy than the county's current energy mix.
- Based on the worst-case scenario of hydroelectric productivity included in SCL's IRP, King County's hydroelectric resources could see a decrease of 2.6% by 2030, decreasing the availability of the county's primary renewable resource.
- A loss in future distributed generation gains would hold DG levels steady at 0.2% of total energy needs, primarily avoiding future growth in the local solar market.

These factors combined would reduce King County's renewable electricity penetration by 8% compared to what is expected in the baseline scenario. However, even in this worst-case scenario, the county would still receive nearly two-thirds of its electricity from renewable resources. This is because of the significant amount of hydroelectric power that the county's utilities either own directly, control under long-term contract, or have preferential purchasing status for through BPA. So long as these key factors do not change, King County is not expected to experience a significant decrease in renewable penetration even in a worst-case scenario.

Figure 5. King County Projected Power Mix by Year; Worst Case Baseline

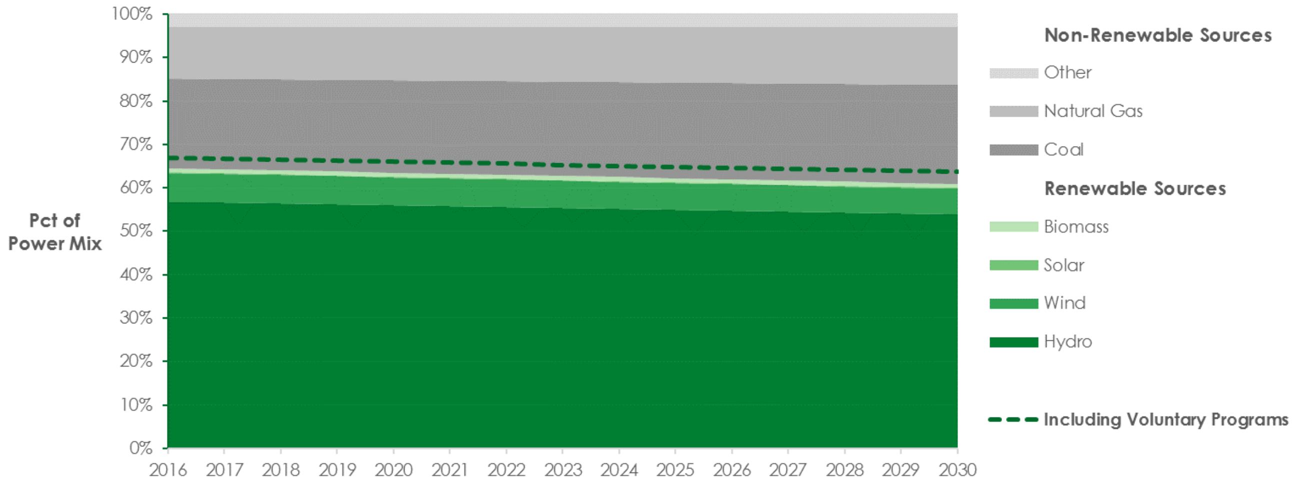

Table 11. Percentage Renewable Electricity Projected; Worst-Case Baseline

Utility	Delivered Utility Power Only		With Voluntary Purchases	
	2016 Baseline	2030 Baseline	2016 Baseline	2030 Baseline
SCL	93%	88%	94%	89%
PSE	40%	40%	44%	45%
King County	**65%**	**61%**	**67%**	**64%**

4. POLICY SCENARIO FORMATION AND IMPACTS

Cadmus worked with King County and K4C staff to develop and review a range of potential policies and programs that would drive an increase in the county's renewable electricity mix, assembling a list of 39 individual policy actions suggested either by the Project Team or by stakeholders. Each policy was assessed for its potential degree of impact on the county's power mix, its cost-effectiveness to the County and to stakeholders, and the expected feasibility of implementation.

Notably, this assessment considered both the potential impacts of a given program or policy as well as the county's level of influence in achieving that impact. As electric power industry policy-making is primarily concentrated at the state rather than local level, there is a trade-off between these two primary factors. Some policies approaches are relatively easy for a local government to implement, and would drive growth in distributed generation markets but are not expected to cause broad changes in utility-scale power mixes. Alternately, many of the major programs or policy initiatives that would dramatically change a utility's power mix are not under the statutory control of local governments, and would require either collaboration with local utilities or action by state-level policy-makers to achieve. Local governments may also consider several options to increase their level of influence over the regional power mix. These strategies, which would allow local governments to take more direct action to affect the renewable power mix, entail significant barriers related to policy feasibility.

These tradeoffs are illustrated in Table 12 below. These broad categories of local government policy action, as well as the individual programs and policy actions considered for inclusion in the scenario analysis, are discussed in more depth in Appendix A.

Table 12. Influence and Impact of Local Government Electric Power Policies.

Policy Category	General Level of Local Government Influence	Anticipated Impact on County Power Mix	Notes
Use City or County Powers	High	Low	Approaches on based permitting, zoning, and use of county facilities fall under direct local government control, but have little impact on large utility-scale generation.
Local Programs and Partnerships	High	Low	Local stakeholder partnerships and program development can be effective in encouraging increases in distributed generation, but not in impacting broader utility power mix.
Partner with Local Utilities	Moderate	Moderate to High	Local governments may be able to form effective collaborative partnerships with utilities to increase renewable share in power mix.
Partner on State Action	Low to Moderate	High	State-level policy changes offer the greatest promise for large-scale changes in power mix. Local governments have opportunities to comment and influence actions individually and collectively.

Following this analysis, Cadmus conferred with King County staff on the development of four strategy bundles (policy scenarios) that assume various, distinct groups of program and policy options that King County could pursue to increase levels of renewable electricity. These strategy bundles reflect different approaches that King County could adopt related to pursuing policies and programs under direct local government control, or those that would require collaboration with state and utility actors. The Project Team modeled the impact each strategy bundle on the county-wide electricity mix through 2030. Details of the assumption and methodology used in this analysis are included in Appendix B.

The following policy scenarios were selected:

1. A scenario in which King County emphasizes and maximizes local action that can be pursued directly by the County and its city partners.
2. A scenario in which King County promotes and seeks to maximize voluntary action by residents and businesses, focusing on the purchase of renewable energy. These policies would entail collaboration with the county's major utilities.
3. A scenario in which King County focuses on state-level carbon pricing policy.
4. A second state-level policy scenario that models a 100% Renewable New Generation policy.

In addition to policies and programs that were selected specifically for each scenario, the standard package of local actions was included in each strategy bundle.

This section describes each of the policy scenarios and the associated modeling results. For all strategy bundles, the Business as Usual scenario is used as the baseline for comparison.

4.1 STANDARD PACKAGE OF LOCAL ACTIONS

Cadmus assumed a package of several shorter-term local actions in all the scenarios. These include measures related to the permitting and zoning authorities of the County and its city partners, the use of County lands and facilities, and community engagement efforts.

These actions have relatively low costs and high feasibility (compared to other potential approaches), but are expected to have relatively small impacts on the county-wide power mix. Still, this standard package of local action was included in each of the policy scenarios as it is assumed to comprise a set of policies and programs that King County could deploy in any scenario to build momentum towards broader impacts.

Table 13. Standard Package of Local Actions (Included in All Scenarios)

Permitting / Zoning / Ordinances	Adopt & standardize permitting practices for distributed energy
	Adopt & standardize zoning best practices for renewable energy
	Adopt & standardize solar ready guidelines for all new construction
	Require new commercial and multi-family construction to include renewable electricity generation
Facilities	Maximize on-site renewable electricity on County & city facilities
	Lease County & city lands for large renewable electricity projects where possible
Community Engagement	Support growth of community-based distributed renewable purchasing programs, like Solarize
	Support Community Solar projects with marketing and outreach, use of county lands as host site, and collaboration with housing authorities as project organizers

Modeling results: The eight standard local actions are primarily expected to impact King County's distributed generation profile. Through strategies like streamlining the solar installation process with permitting and zoning improvements, participating directly in local distributed generation market by siting renewable electricity projects on county-owned facilities and lands, and in supporting and expanding initiatives like Solarize group purchasing programs and community solar projects, King County and its partner cities can have a moderate policy impact on local renewable electricity production. Based on benchmarks of what similar policies have accomplished elsewhere, these policies could have a direct impact of more than 3 MW in new distributed generation capacity per year (this is the equivalent to more than 600 typical residential rooftop solar installations, sized at 5 kW each).

In comparison, an estimated 35 MW of renewable electricity generation was in service in King County in 2016, accounting for 0.2% of the county's needs. In the BAU forecast and based on current installation rates, this is expected to nearly quadruple, growing to account for over 0.7% of the county's electricity needs. This standard package of local actions is projected to increase the rate of growth in local distributed generation markets by up to 40%, adding 42 MW of additional renewable distributed generation capacity by 2030.

While this change would be impactful when viewed from the perspective of King County's distributed generation market, it would have only a small impact on the county's power mix. Accounting for the potential impact of these policies, distributed generation would account for 0.9% of the county's power mix by 2030, and would have a minimal impact on the county's renewable electricity penetration (an overall increase of only 0.12% beyond BAU expectations).

The benefits of this package of policy actions, however, go beyond their impact on the county-wide power mix. These strategies are still included in each policy scenario as a starting point for King County because they:

- Have relatively low barriers to implementation.
- Demonstrate the commitment of the County and its city partners to acting on renewable electricity goals. Have high visibility in local communities and can result in direct financial benefits to impacted residents and businesses.
- Provide an opportunity for the County to lead by example.
- (In some cases) can be deployed in a manner that achieves non-energy benefits. For example, if King County's support of Solarize programs could incorporate a focus on low-to-moderate income families, or it could partner with the King County Housing Authority to implement a community solar projected benefitting KCHA residents.

4.2 SCENARIO A: EMPHASIS ON LOCAL ACTION

This scenario models the impact of additional local County or city policies promoting renewable energy, and reflects a strategy of independent local action. While these strategies may be more challenging to implement than the package of standard local actions above, they have greater potential impacts and demonstrate the extent to which local government can independently impact their electricity supply through direct local government action. These policy actions were selected as they provided relatively high levels of expected impact compared to other potential local government actions, despite their expected difficulty of implementation. They include:

Table 14. Actions to Maximize Local Policy

Permitting / Zoning / Ordinances	Require new commercial and multi-family buildings to achieve net zero energy
New Local Programs	Establish and fund local incentives for renewable electricity projects (with a focus on also achieving equity, workforce, and other benefits)
	Prioritize electricity generation in existing county bioenergy projects

Modeling results: Each of these policies would have impacts that go beyond the electricity generation sector. A county-wide net zero energy policy would, in addition to resulting in an increased rate of distributed generation, also yield a considerable amount of energy savings (which are not modeled in this analysis due to its focus on electricity generation). The Project Team bases its analysis of a local solar generation program on the GoSolarSF program implemented in San Francisco, which emphasizes incentive payments to low-income households and to residents in designated environmental justice neighborhoods. It is assumed that a similar approach could be taken in King County, and that such a project would be developed with an equity focus in mind. An emphasis on electricity generation from bioenergy production, however, could have deleterious effects on other areas of King County's climate goals, as it would entail a shift away from the production of biogas for sale to natural gas providers.

These policies would drive a substantial increase in distributed generation production in King County, which would increase to 6.1% of the county's overall electricity mix in 2030 under this scenario.[29] This increase in distributed generation would reduce the amount of market purchases needed on the part of utilities, and would increase the county-wide penetration of renewable electricity to 75% by 2030, compared to 72% in the baseline scenario.

As shown in the graphic below, these policies would lead to noticeable increases in non-hydro renewables (wind and solar from a net zero energy policy, solar from a dedicated incentive program, and biomass from reprioritized biogas production). Of these three policies, the largest impact would come from a county-wide net zero energy policy, which accounts for roughly three quarters of this additional impact.

The results of this scenario demonstrate the limitations of relying on new distributed generation resources alone to meet King County's energy goals. Even a set of policy actions that increases the amount of distributed generation capacity in the county nearly ten times over baseline expected levels would result only in a modest increase in the county-wide renewable electricity mix, as it would not cause a change in

[29] This projection does not consider technical issues related to accommodating higher amounts of generation in the county's distribution network, though this is anticipated to be a factor in the feasibility of a high penetration of local distributed renewable energy generation.

the utility-owned fossil fuel generation fleet that makes up the majority of King County's non-renewable power sources.

Figure 6. King County Projected Power Mix by Year; Independent Local Action Scenario

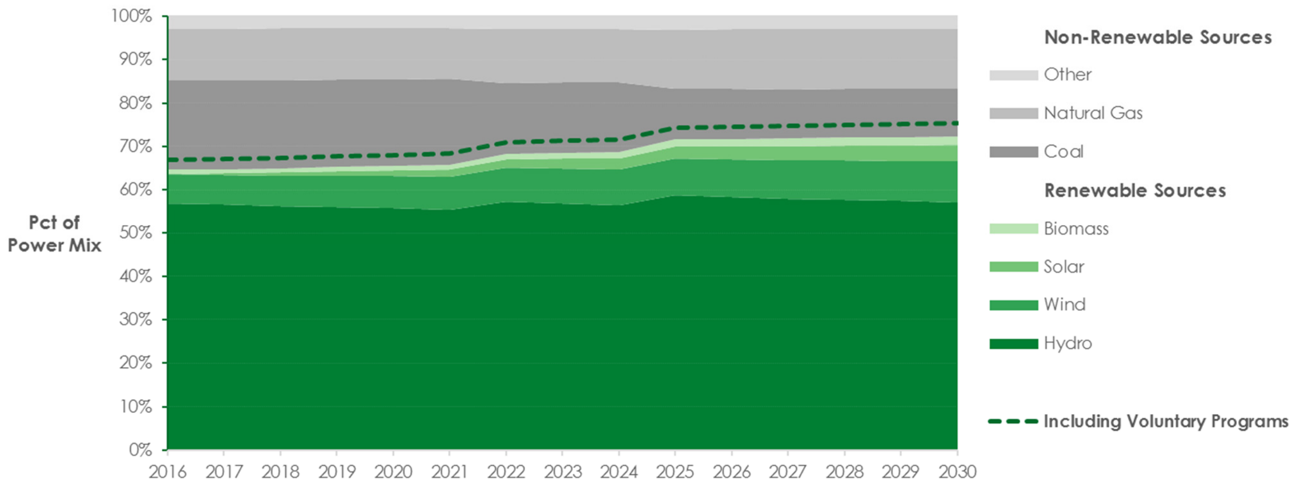

Table 15. Percentage Renewable Electricity Projected; Independent Local Action Scenario

Utility	Delivered Utility Power Only 2016 Baseline	2030 Baseline	2030 Policy Impact	With Voluntary Purchases 2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	93%	94%	93%	93%
PSE	40%	51%	56%	44%	55%	61%
King County	**65%**	**69%**	**72%**	**67%**	**72%**	**75%**

4.3 SCENARIO B: MAXIMIZE VOLUNTARY RENEWABLE ELECTRICITY PURCHASES

A second high-renewable scenario demonstrates the potential impact that an emphasis on voluntary renewable electricity purchases could have on King County's power mix. There are many possible pathways to encourage or enable voluntary renewable electricity purchases (such as non-utility REC programs, virtual PPAs, direct access programs, and programs such as community choice aggregation that allow for municipal control over electricity purchases). The options below were selected through conversations with King County and K4C staff and reflect both stakeholder preferences for programs that emphasize utility collaboration and that result in new regional generation capacity in the Pacific Northwest.

The voluntary purchasing scenario includes two primary strategies, both of which entail a partnership with local utilities. The first is to increase the ability of customers to develop distributed renewable generation through an on-bill repayment or financing program, creating new opportunities for county residents and businesses to finance the costs of renewable electricity installations (primarily solar). The second is to increase participation in utility-sponsored renewable electricity purchasing programs, such as the REC-based Green Up (SCL), Green Power (PSE) and Solar Choice (PSE) programs, and the PSE Green Direct Tariff.

The utility collaborations considered in this policy are in line with PSE's plan to reduce its greenhouse gas emissions 50% by 2040, which highlights the Green Direct tariff as an example of new customer products that will enable the utility to increase renewable generation.[30]

Table 16. Actions to Maximize Voluntary Renewable Electricity Purchase

Utility Collaboration	Co-develop utility on-bill repayment programs to expand financing for local distributed electricity projects to market segments with poor access to finance
	Encourage expanded participation in REC-based green power programs in the residential and small commercial markets
	Encourage expanded participation in the PSE Green Direct programs in the large and medium commercial markets

The expansion of PSE's Green Direct program was raised as an area of interest by several stakeholders. Several stakeholders noted that such a tariff-based program could provide a vehicle for dramatic increases in renewable energy purchase given a critical mass in customer interest, or that a program could be operated on an opt-out basis for all utility customers akin to Community Choice Aggregation programs in other states. As noted in the Appendix A policy detail, such an opt-out approach to Green Direct may experience significant barriers to implementation, and so this scenario primarily considers an expansion in the current program that serves larger commercial electricity consumers. However, given stakeholder interest, Cadmus does evaluate the impacts of this policy approach as a second variant on this scenario.

Modeling Results: While a successful on-bill repayment or financing program could provide modest growth in the local distributed electricity market, the primary impact of this strategy would be the growth in utility-based purchasing programs. If, through the support of King County and its partner cities, these programs were to become nationwide leaders in enrollment rates, the resulting voluntary purchases would increase the county's share of renewable electricity to 80%. This strategy would not require an underlying change in the generation assets owned or contracted by utilities (the renewable share of delivered power would only increase from 69% to 70% because of on-bill tariffs), as customer participation in voluntary programs would instead be used to offset generation from utility-owned fossil fuel assets.

[30] See PSE carbon plan press release, available at: https://pse.com/aboutpse/PseNewsroom/NewsReleases/Pages/PSE-to-reduce-its-carbon-footprint.aspx

Figure 7. King County Projected Power Mix by Year; Voluntary Purchases Scenario

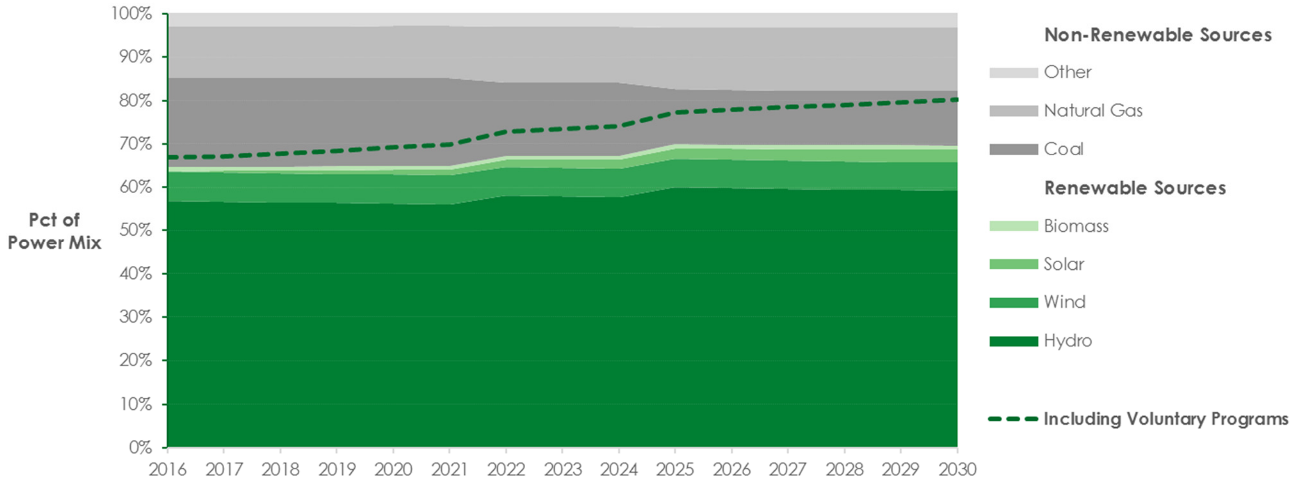

Table 17. Percentage Renewable Electricity Projected; Voluntary Purchases Scenario

Utility	Delivered Utility Power Only			With Voluntary Purchases		
	2016 Baseline	2030 Baseline	2030 Policy Impact	2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	92%	94%	93%	97%
PSE	40%	51%	51%	44%	55%	66%
King County	**65%**	**69%**	**70%**	**67%**	**72%**	**80%**

Opt-Out Policy Variant

The above analysis assumed that voluntary utility programs such as Green Direct would continue to be offered on an opt-in basis. While there may be more significant barriers to implementation, such a program could also be implemented on an opt-out basis, akin to the design of Community Choice Aggregation (CCA) programs in other states but still structured through existing utility tariffs.

If such an approach were implemented, and opt-out rates were to be similar as what has been seen in CCA programs in other states, the amount of renewable electricity purchased through the program would be substantial and enough to satisfy the county's 90% electricity target, with a projected renewable power share of 94%. The specifics of such a program's impact, however, are unclear. If such a program were to be implemented based on REC purchases (as with the Green Up, Green Power, and Solar Choice programs), such a program could be managed without affecting the mix of owned and contracted utility assets (County utilities could continue to operate their generation fleets as they currently do, and would arrange for REC purchases to fulfill customer demand where necessary). If such a program were to be based more on PSE's Green Direct tariff, in which the utility agrees to purchase a set amount of power (including RECs) from designated renewable electricity producers and to re-sell this to customers through a dedicated tariff, then changes to utility generation fleets would be necessary as King County's utilities would face a generation surplus.

Table 18. Percentage Renewable Electricity Projected; Voluntary Purchases Scenario (Opt-Out Variant)

Utility	Delivered Utility Power Only			With Voluntary Purchases		
	2016 Baseline	2030 Baseline	2030 Policy Impact	2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	92%	94%	93%	98%
PSE	40%	51%	51%	44%	55%	90%
King County	**65%**	**69%**	**70%**	**67%**	**72%**	**94%**

4.4 SCENARIO C: IMPLEMENT STATE-WIDE CARBON PRICE

The third and fourth high-renewable scenarios are statewide policy options that would provide high levels of impact but would require state-level action either through the legislature or the ballot initiative process. While King County does not have direct authority to enact this category of policies, it is able to collaborate with business, advocacy, utility, and governmental groups to lend support to various state-level policy approaches. Based on discussions with King County staff and stakeholders, Cadmus selected two specific state policy actions to evaluate as scenarios.

In the first approach, discussed here, Washington State would enact a carbon pricing policy, effected as a tax or fee on emissions. While there are multiple ways in which such a policy could be implemented (such as an increase in the state RPS requirement), this analysis models a scenario in which a carbon price is implemented with the primary result by 2030 of rendering coal generation economically uncompetitive.

Modeling results: Whereas the above strategies would primarily entail an increase in distributed generation that mostly displaces market purchases, or the voluntary purchase of renewable electricity that does not displace broader utility purchasing strategy, a state-level carbon pricing policy would have direct supply-side impacts on the generation sources owned and operated by the county's utilities, and the mix of power purchased from the regional grid.

If the Washington state government were to place a price on carbon, it is projected that coal electricity would be nearly completely phased out of King County's power mix by 2030. In the short term, this generation would mostly be made up for by a decrease in regional power exports, and so there would be little additional impact beyond the decline of coal. While coal is projected to be completely removed from the county power mix by 2030, such a policy would result in a moderate increase in the share of natural gas. This is both because the closure of utility-owned coal plants would lead to an increase in market purchases (which includes natural gas), and because in the short term the regional use of natural gas would be expected to rise to replace lost coal generation. The share of renewable electricity in the county's power mix is expected to increase in 2030, in part because of the direct investment in new renewable resources but also because of the resulting higher share of renewables in the blend of market purchases. By 2030, a carbon price is expected to result in an 80% renewable electricity share in King County's power mix.

In the longer term, a carbon price is expected to lead to deeper changes in the regional power mix. The power mix forecasts incorporated in this analysis project a significant amount of new renewable electricity to be developed by 2050 because of the carbon policy, but that these resources would mostly be developed in the years after 2030. Therefore, while a carbon policy alone is not projected to achieve King County's renewable electricity goal by 2030, it is expected to alter long-term electricity planning in the region in a manner that can support longer term market transformation.

Figure 8. King County Projected Power Mix by Year; Carbon Pricing Policy Scenario

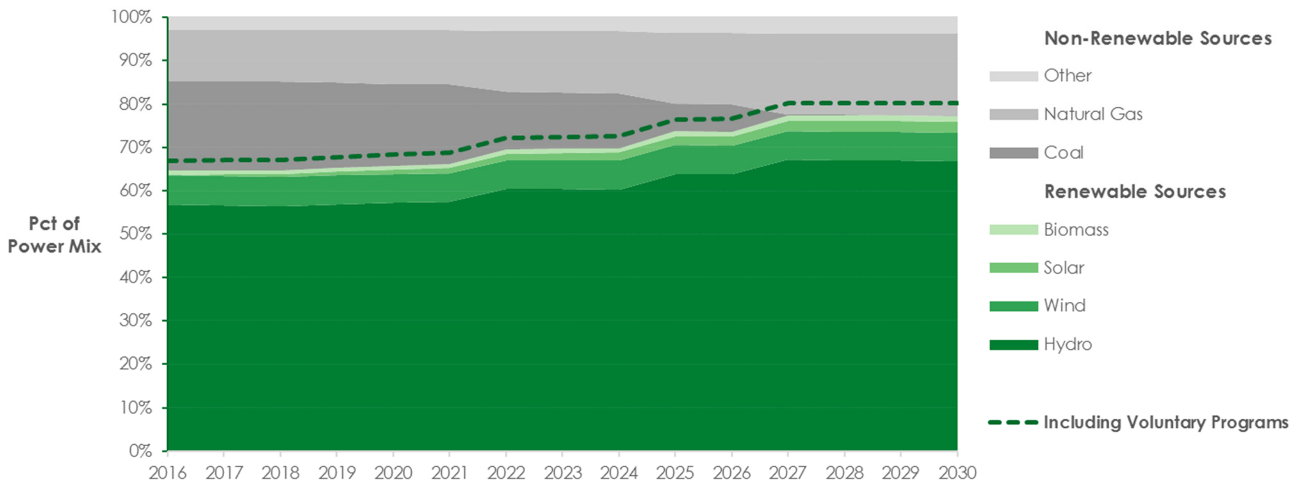

Table 19. Percentage Renewable Electricity Projected; Carbon Pricing Policy Scenario

Utility	Delivered Utility Power Only			With Voluntary Purchases		
	2016 Baseline	2030 Baseline	2030 Policy Impact	2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	93%	94%	93%	94%
PSE	40%	51%	64%	44%	55%	69%
King County	**65%**	**69%**	**77%**	**67%**	**72%**	**80%**

4.5 SCENARIO D: ENACT 100% RENEWABLE NEW GENERATION POLICY

The final policy scenario modeled reflects the impact of another state-level policy that has been proposed in Washington and that was suggested in stakeholder conversations: a requirement that all new generation capacity developed be from renewable sources.

As with a carbon price, a 100% Renewable New Generation policy would drive long-term changes in the state's power sector and impact long-term utility generation supply decisions. As power plants in the state's thermal generation fleet gradually reach their end of life and retire, these would be replaced solely by renewable sources. Given a long enough time, this policy could essentially ensure that King County's power mix is nearly completely renewable as existing generating plants reach the end of their useful lives (this would be limited only by any market purchases from fossil fuel generators that may be allowed, or by extensions to the lifetime of current non-renewable facilities).

As this policy would only impact decisions about new generation capacity rather than the use of current generation capacity (in comparison, a carbon policy would do both), the rate at which a 100% Renewable New Generation policy would impact King County's power mix would depend on the rate at which utilities must develop new generation capacity either to replace plant retirements or to serve increasing loads. As discussed in further detail in the Appendix B methodology overview, this analysis considered two scenarios for the rate of new generation construction. The first is based on utility integrated resource plans and is assumed to be the most likely case, and the second is based on accelerated schedule of fossil fuel plant depreciation and retirement and would yield a higher impact in the short term.

Modeling results: While both scenarios project only limited impacts in the study period ending in 2030, a 100% Renewable New Generation policy would be expected to have deeper impacts on King County's power mix in future decades. As with the carbon policy discussed above, such an approach would fundamentally alter utility and regional power planning, and impacts would be expected to escalate over time as the generation fleet was completely replaced with renewable resources.

Results Based on Current Utility Plans

The first analysis identifies current plans for new non-renewable generation among King County's utilities, and assumes that this new capacity need would instead be met by other sources.

In the current IRPs developed by SCL and PSE, there are no plans for new baseload fossil fuel generation. SCL does not anticipate developing any new capacity resources to serve its future loads in this study period. PSE does project the need for substantial new investments to meet future demand, but this would result in minimal new fossil fuel generation. PSE anticipates a need to invest in 3 GW of new peak capacity, but expects that non-generation resources (a combination of energy efficiency, demand response, energy storage, and improved transmission) will meet nearly 40% of this need. In addition to nearly 500 MW of new solar capacity, PSE does expect to develop nearly 1,200 MW of new thermal generation (which will most likely be natural gas). However, this new non-renewable generation would be developed as peaking plants, not baseload generation, meaning that these plants would be used sparsely throughout the year and only dispatched in peak demand times, which would result in only a minor impact on the county's overall power mix.

In the short period reflected in this study's time horizon, the impacts of this policy would primarily be to replace these thermal combustion turbine-based peaker plants with carbon-free sources of demand capacity (such as storage or demand response), which would have only a modest impact on King County's power mix, raising the share of renewable electricity from 72% in the BAU forecast to 73%.

Under this scenario, the share of natural gas in King County's power mix would increase by 2030, because (as in the BAU baseline scenario) PSE would be expected to increase its purchases of electricity from the regional market to replace retired coal generation. However, a lower amount of natural gas consumption is projected in 2030 under this scenario than in the baseline scenario. While this scenario does not meet 90% renewable by 2030, it does establish a framework for long term and persistent carbon emissions reductions.

Figure 9. King County Projected Power Mix by Year; 100% Renewable New Generation Scenario (Based on IRPs)

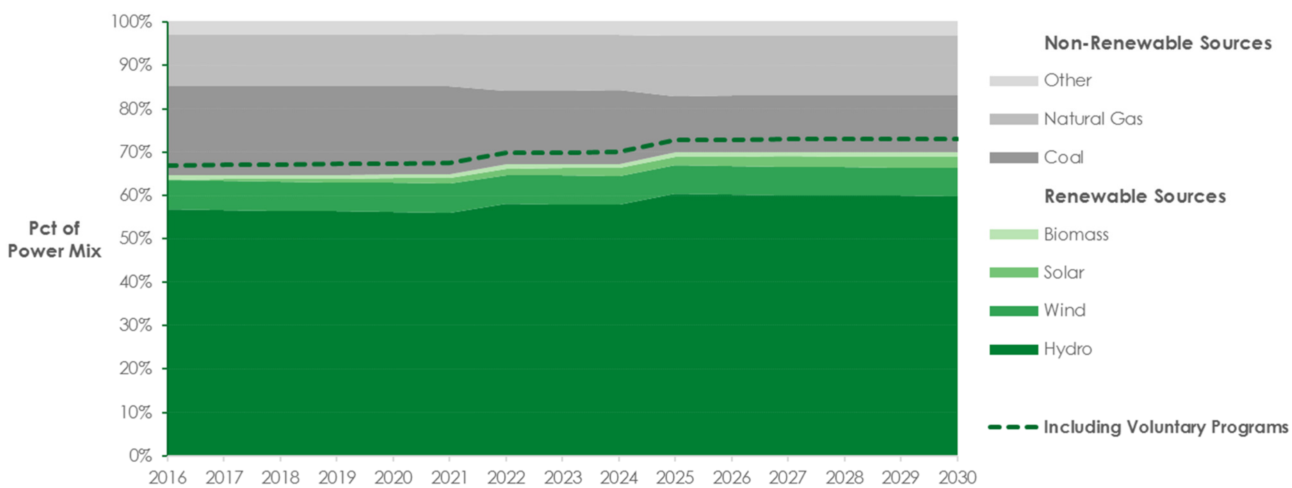

Table 20. Percentage Renewable Electricity Projected; 100% Renewable New Generation Scenario (Based on IRPs)

Utility	Delivered Utility Power Only			With Voluntary Purchases		
	2016 Baseline	2030 Baseline	2030 Policy Impact	2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	92%	94%	93%	93%
PSE	40%	51%	52%	44%	55%	57%
King County	65%	69%	70%	67%	72%	73%

Results Assuming Accelerated Plant Retirements

This second analysis assumes an accelerated rate of plant retirements during the study period (further discussed in Appendix B). Under this scenario, it is assumed not only that units 3 and 4 of the Colstrip generation plant (which met roughly 11% of PSE's power needs in 2016) are retired upon their depreciation in 2027, but that the Fredonia, Frederickson, and Encogen natural gas plants (which combined to meet about 2% of PSE's 2016 power needs) would be depreciated and retired in the study period as well.

As PSE's IRP does not project the construction of new baseload capacity to replace the Colstrip plant, it is assumed that the additional retirement of these smaller natural gas plants would also not result in the development of new baseload capacity, but that these resources would be replaced with market purchases. In this scenario, the renewable electricity share of King County's power mix would increase to 76% by 2030.

Figure 10. King County Projected Power Mix by Year; 100% Renewable New Generation Scenario (Accelerated Retirement)

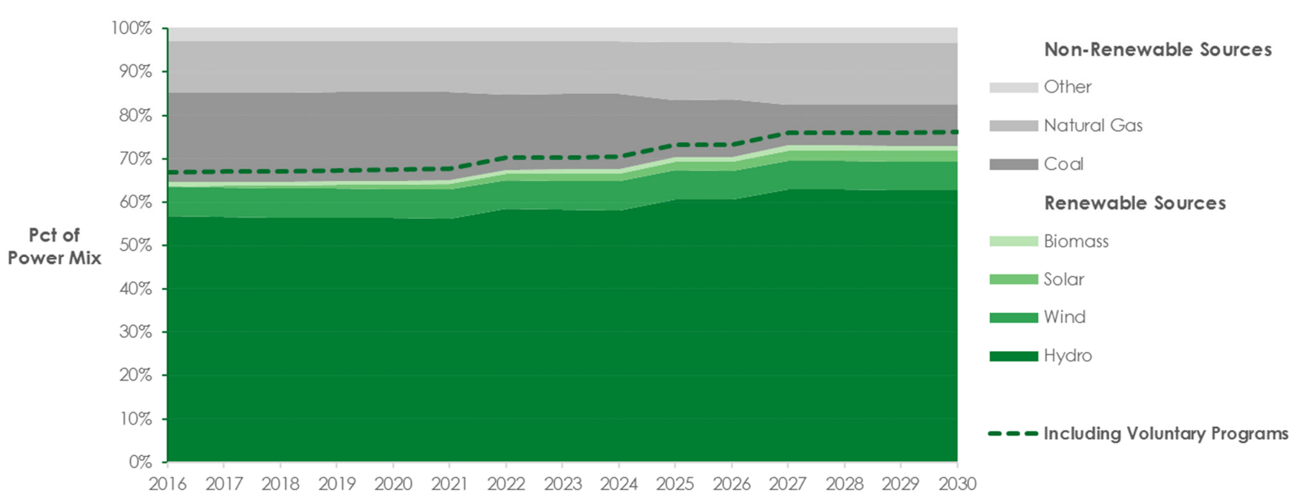

Table 21. Percentage Renewable Electricity Projected; 100% Renewable New Generation Scenario (Accelerated Retirement)

Utility	Delivered Utility Power Only			With Voluntary Purchases		
	2016 Baseline	2030 Baseline	2030 Policy Impact	2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	92%	94%	93%	93%
PSE	40%	51%	57%	44%	55%	62%
King County	65%	69%	73%	67%	72%	76%

4.6 SCENARIO IMPLEMENTING ALL ACTIONS

In each of the scenarios discussed above (except for an opt-out green electricity program), King County's renewable electricity power mix is projected to fall short of the 90% target by 2030. However, it should be noted that both potential state policies – a state price on carbon and a 100% Renewable New Generation policy – are expected to continue to increase the share of renewable electricity in the decades following 2030.

This analysis reveals a potential pathway to achieving King County's goal of 90% renewable electricity by 2030, though this would depend on simultaneous and aggressive action to maximize independent local policy actions, to work with utilities to expand customer renewable electricity purchases, and to engage state policy-makers to put in place large-scale policy impacts.

Table 22 below provides an overview of the specific strategies and policies included in the strategy scenarios.

A final possibility considered the impact of pursuing all the above strategies in tandem. In such an approach, King County would:

- Pursue the package of standard package of local policy actions.
- Take additional local policy steps to maximize distributed generation.
- Partner with county utilities to expand voluntary customer renewable electricity purchases.[31]
- Partner with state policy-makers to enact both a state wide price on carbon policy and a 100% Renewable New Generation policy.[32]

[31] This combined scenario assumes that this would be done no an opt-in, rather than opt-out, basis.
[32] This combined scenario relies only on utility IRPs to determine the impacts of a 100% Renewable New Generation policy.

Table 22. Summary of Policy Actions included in Scenario Modeling

Category	Strategy	Maximize Local Action	Maximize Voluntary Action	State Policy: Carbon Pricing	State Policy: 100% Renewable New Generation
Use of City or County Powers	Permitting Improvements	Yes*	Yes*	Yes*	Yes*
	Renewable Electricity Zoning Ordinance	Yes*	Yes*	Yes*	Yes*
	Solar Ready Guidelines	Yes*	Yes*	Yes*	Yes*
	Net Zero Energy Building Codes	**Yes**	Yes*	Yes*	Yes*
	Mandates for Local Distributed Generation	Yes*	Yes*	Yes*	Yes*
	County-Sited Renewable Electricity Projects	Yes*	Yes*	Yes*	Yes*
	Lease Public Lands for Renewable Energy	Yes*	Yes*	Yes*	Yes*
Create or Expand Local Initiatives	Support Community Solar Programs	Yes*	Yes*	Yes*	Yes*
	Support Renewable Electricity Group Purchasing	Yes*	Yes*	Yes*	Yes*
	Local Incentives for Renewable Energy	**Yes**			
	Expand Bioenergy Production	**Yes**			
Partner with Local Utilities	Promote Expanded REC Purchases		**Yes**		
	Expanded Utility Green Tariff Program		**Yes**		
	Establish On-Bill Repayment / Financing Program		**Yes**		
Partner on State Action	Enact a State wide Price on Carbon			**Yes**	
	Establish a 100% Renewable New Generation Policy				**Yes**

Yes denotes strategies that were included in the Standard Package of Local Actions, which is applied to all the strategy bundles.*

Due to the combined impact of policies that encourage new in-county distributed renewable resources, this analysis yields a 2030 distributed generation amount that is equivalent to 6.5% of King County's power needs. Due to the impact of a state-wide carbon policy, PSE would cease its use of coal generation by 2030, replacing power from Colstrip units 3 and 4 with regional market purchases, and these purchases would have a higher share of renewables due to a region-wide decline in the use of coal. PSE would also develop alternatives to the planned 1200 MW of peaking thermal generation due to the 100% Renewable New Generation policy.

These impacts combined could increase the renewable electricity portion of utility power delivered to King County to 80%. Including the additional impact of expanded voluntary renewable electricity purchases by customers, this scenario yields a final renewable electricity power mix of 91%.

Figure 11. King County Projected Power Mix by Year; All Policy Scenarios Combined

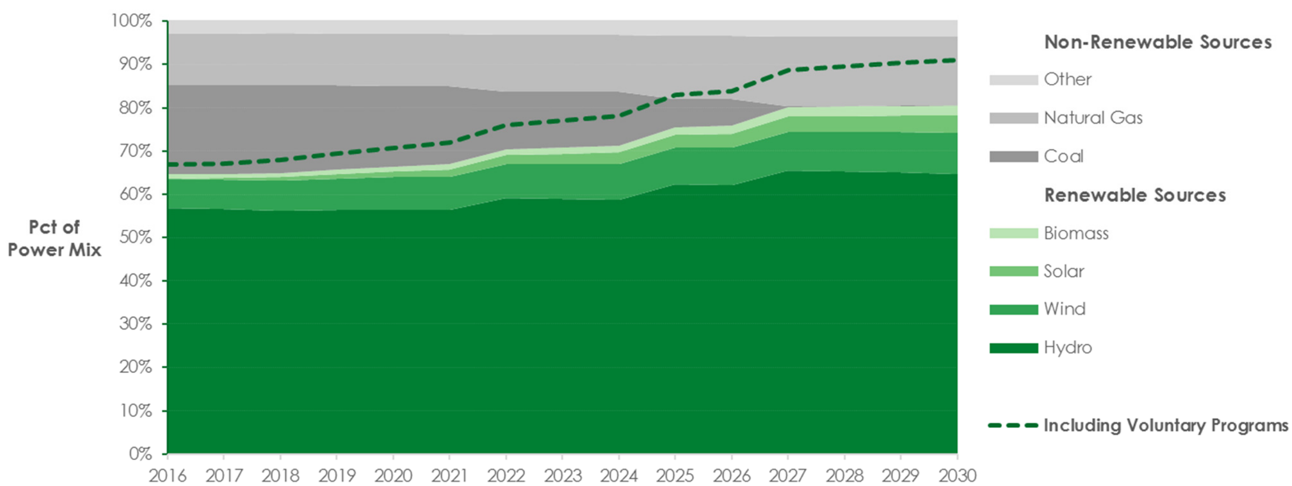

Table 23. Percentage Renewable Electricity Projected; All Policy Scenarios Combined

Utility	Delivered Utility Power Only			With Voluntary Purchases		
	2016 Baseline	2030 Baseline	2030 Policy Impact	2016 Baseline	2030 Baseline	2030 Policy Impact
SCL	93%	92%	94%	94%	93%	99%
PSE	40%	51%	70%	44%	55%	85%
King County	**65%**	**69%**	**81%**	**67%**	**72%**	**91%**

5. SUMMARY OF IMPACTS

5.1.1 Power Mix Impacts

The results of all modeling scenarios are summarized in Table 24 below.

Table 24. Percentage Renewable Electricity Projected Across All Scenarios.

Scenario		SCL	PSE	King County
2016 Power Mix		94%	44%	**67%**
2030 - Baseline Scenarios	Business as Usual	93%	55%	**72%**
	Early Colstrip Retirement	93%	60%	**75%**
	Worst Case	89%	45%	**64%**
2030 – Policy Scenarios	Standard Recommended Local Actions Only	93%	56%	**73%**
	Maximize Local Actions	93%	61%	**75%**
	Maximize Voluntary Actions	97%	66%	**80%**
	Opt-Out Voluntary Programs (Variant)	98%	90%	**94%**
	Carbon Pricing Policy	94%	69%	**80%**
	100% Renewable New Generation Policy	93%	57%	**73%**
	100% Renewable w/ Retirements (Variant)	93%	62%	**76%**
	All Policies (Excluding Variants)	99%	85%	**91%**

As noted above, while each individual set of policy strategies would make progress towards King County's 90% renewable electricity target, none are projected to result in the necessary changes to achieve King County's targets alone. When the impact of all strategies, however, King County is projected to have a pathway to meet its 2030 target.

Meeting this target requires several significant changes in the makeup of King County's electricity mix:

Expansion of distributed generation. In the combined policy scenario, distributed generation is projected to account for 6.5% of the county's overall electricity needs. This is an increase of more than 30x over the current market share of distributed generation (0.2%). For reference, distributed generation would increase more than threefold by 2030 if current installation rates hold constant. Implementing all the local regulations and policy initiatives necessary to achieve these rates of distributed generation is expected to be challenging. Such a significant increase in distributed generation would be expected to require significant upgrades in distribution grid infrastructure the costs and complexity of which are not considered in this analysis.

Reduction in utility-controlled fossil fuel assets. In 2016, King County received roughly 28% of its power from fossil fuel sources that were owned by the county's utilities (these facilities are all owned by PSE, as all of SCL's own generation is from renewable sources). Clearly, this amount must be reduced if King County is to meet its 90% target (particularly as King County also receives some amount of non-renewable electricity through market purchases and BPA contracts). The planned closure of the Transalta plant and Colstrip units 1 and 2 would reduce this amount to 17% in the BAU scenario. The combined impact of a statewide carbon policy and a 100% Renewable New Generation policy would be to additionally cause the retirement of Colstrip units 3 and 4 and the avoidance of planned peaking natural gas capacity additions. These changes would further reduce the share of King County's electricity generated from utility-owned fossil fuel assets to 10%. Further reductions in this amount would be difficult to achieve, as PSE's IRP does not contemplate the retirement of its remaining natural gas resources within the IRP planning period. Based on this analysis, it is difficult to envision a pathway to 90% by 2030 that does not include the full closure of the Colstrip power plant before 2030. The accelerated closure of all units of Colstrip aligns with goals established by King County and partners - in the Strategic Climate Action Plan and in shared commitments King County and K4C partners seek to phase out coal-generated electricity by 2025.

Reduction in fossil fuels from market purchases. Regional market purchases accounted for 9% of King County's electricity mix in 2016, a figure that is expected to rise to just over 20% by 2030, due primarily to the planned closures of PSE's coal assets. In 2016, 44% of these market purchases were from renewable resources. For King County's electricity target to be met, either the share of renewable electricity in the regional short-term market must increase, or King County's utilities must develop additional renewable electricity projects that reduce the amount of market purchases that are necessary. The carbon price policy included in this policy achieves the former by eliminating coal power from the regional power mix. It is anticipated that, in the long term, either a carbon price policy or a 100% Renewable New Generation policy would cause King County's utilities to invest directly in new renewable generation, though these impacts may not occur by 2030.

Growth in Voluntary Customer Purchases. The final key change in King County's power mix is an increase in the share of residents and businesses that currently participate in voluntary renewable electricity programs. This is because, even combining the above impacts, it is expected that the power delivered in King County would reach a renewable electricity level of around 81%, short of the County's goal. Currently, the combined impact of voluntary purchasing programs increases King County's renewable electricity penetration by an estimated additional 2.5%. This is expected to increase to 3.1% in 2030 in the baseline scenario, based on the historical growth rate in REC-based programs and the authorized amount of capacity in the PSE Green Direct Tariff. In the policy scenarios, these programs would need to provide around a 10% increase in King County's renewable electricity mix for the County to reach its goal.

Contributions from Both Utilities. At the utility level, SCL currently sources more than 90% of its power supply from renewable resources.[33] However, for the county as a whole to reach 90% renewable energy, the share of renewable electricity in SCL's power mix must also increase. As an investor-owned utility

[33] SCL currently purchases carbon offsets to account for the non-renewable portion of its electricity supply, allowing it to claim carbon neutrality. However, as most of these carbon offsets are purchased from non-electricity sources, these do not fit within the definition of renewable electricity adopted by King County for this analysis and so are not included here.

without BPA purchasing priority and with significant fossil fuel generation assets, PSE faces significant barriers to meeting 90% renewable electricity penetration. This analysis reveals that the easiest path for the County to achieve its 90% target would be to work with SCL to continue to increase its renewable electricity share, providing a degree of flexibility for PSE. In the combined policy scenario modeled here, SCL would ultimately reach a renewable electricity penetration level of 99% in 2030, and PSE would reach 85%, for a weighted average renewable power mix of 91%.

5.1.2 Cost Impacts

This analysis does not include a direct quantification of the expected costs of achieving King County's 90% Renewable Electricity target. In general, as these planning scenarios consider the development of new energy resources through 2030, the uncertainty of future generation costs of various technologies complicates a direct cost comparison. Globally, while the prices for electricity from utility-scale wind and solar generation facilities have historically been higher than those from fossil fuels, these have continued to fall through 2017 with projections for electricity costs from renewable resources to be on par or cheaper than most fossil fuel generated electricity in the future.[34]

In addition to generation costs, the ultimate cost of the above policy actions will also depend the amount of additional grid infrastructure necessary to support new generation assets, whether a transition will leave utilities with stranded generation assets, the costs of administering any of the above policy actions, and other factors. Additionally, an accounting of policy costs will depend on whether an analysis considers only the direct financial impacts of policy actions (such as an impact on electricity rates), or if non-financial costs and benefits (such as the avoided costs of emitted carbon) are considered as well in a societal cost-benefit study.

Washington State's policy and regulatory environment mandates that utilities procure power from a least cost mix of energy and conservation, considering direct costs of generation or power purchases. As one data point on the comparative costs of different generation technologies in today's environment, Seattle City Light's 2016 IRP determined new hydroelectricity resources to be the least cost on a levelized cost per kilowatt-hour basis, followed by natural gas and wind.[35] While it is difficult to predict the relative costs of various energy generation technologies in the future, it is possible to envision the relative cost impacts of various policy scenarios and for different classes of customers.

Given the economics of scale involved in renewable energy project development, scenarios that emphasize the development of distributed generation resources (such as the use of local government powers to develop DG resources) are expected to be less cost-effective overall than scenarios that emphasize utility-scale changes (such as a state carbon pricing policy). However, distributed generation approaches may provide benefits to King County residents and businesses that are able to develop their own distributed

[34] International Renewable Energy Agency, 2017 Renewable Power Generation Costs, available at: http://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017

[35] SCL 2016 IRP, Appendix 5.

generation resources cost-effectively under state net metering policies. Among broader state-level policy changes, prior research on regional policy has shown strategies such as a carbon price or emissions cap to be a relatively cost-effective means of achieving greenhouse gas emissions reductions, and a "No New Gas" policy akin to the 100% Renewable New Generation policy considered here to result in comparatively high costs and low impacts.[36]

Customers of the county's two utilities may be expected to bear different degrees of cost impact as a result of policy action. As a larger change would be needed in PSE's power mix than in SCL's for the County to reach its 90% renewable energy target, PSE customers may be expected to bear a larger share of any future electricity price increases or other costs than their SCL counterparts. Additionally, policy actions such as a carbon pricing scheme would be expected to have a greater impact on PSE (and ultimately its customers) than on SCL, due to the higher share of fossil fuel electric generation in PSE's power mix.

5.1.3 Equity Impacts

The above four policy scenarios also differ in terms of their projected ability to provide non-energy benefits, such as equity impacts. To consider the equity impacts of the different strategies, Cadmus grounded its approach in a holistic definition of equity from the Urban Sustainability Directors Network. The definition considers four (often overlapping), aspects of equity, listed in the box below.[37]

Procedural (Inclusion): inclusive, accessible, authentic engagement and representation in the process to develop or implement programs or policies.

Distributional (Access): programs and policies result in fair distributions of benefits and burdens across all segments of a community, prioritizing those with highest need.

Structural: decision-makers institutionalize accountability; decisions are made with a recognition of the historical, cultural, and institutional dynamics and structures that have routinely advantaged privileged groups in society and resulted in chronic, cumulative disadvantage for subordinated groups.

Transgenerational: decisions consider generational impacts and don't result in unfair burdens on future generations.

A transition in King County to greater levels of renewable resources is expected to have equity implications in several ways:

- Procedural and Structural Equity: These elements of equity would depend on the specific program design and implementation details of each policy strategies. However, as discussed below, the County would have a more direct opportunity to facilitate these types of equity within the locally-focused strategies as compared to within the state-level action strategies.

[36] Energy+Environmental Economics, *Pacific Northwest Low Carbon Scenario Analysis*. Available at: http://www.publicgeneratingpool.com/e3-carbon-study/

[37] Angela Park. "Equity in Sustainability: An Equity Scan of Local Government Sustainability Programs." Urban Sustainability Directors Network, September 2014.

- Distributional Equity: Most of the equity analysis for a renewable energy transition relates to distributional equity. This includes both the distribution of costs of policies and programs, as well as the distribution of benefits. Key benefits considered include potential community economic development (job creation, reinvestment into local economy, and savings on energy bills) and the impact on local community health. Generally, health impacts are expected to be positive but to distributed broadly, rather than within King County directly. The most direct health impacts would be in the communities surrounding the areas of fossil fuel generation plants.
- Transgenerational Equity: Transgenerational equity would hold similar benefits across all strategies, and would relate primarily to the reduction in greenhouse gas emissions that would burden future generations.

Equity impacts are discussed broadly for each major set of policy actions below.

Package of Standard Local Actions

Several of the local policy actions (such as streamlined permitting and zoning, and solar ready guidelines) are intended to reduce barriers to distributed generation development. While these policies could theoretically benefit any King County resident or business interested in developing distributed generation, it is likely that the financial benefits of participation would primarily accrue to building owners with ready access to capital. Without additional program measures in place to reduce participation barriers to low- and moderate-income residents, these benefits may not be distributed evenly. Other program measures to offer training and employment opportunities for low-income and underrepresented communities could increase economic equity.

Conversely, community-based programs, such as support of an expanded Solarize group purchasing program or of community solar projects, provide the County with direct opportunities to tailor program designs to the needs of residents that may face barriers to distributed generation. For example, a community solar program could be designed in a way to encourage participation from these customers, such as through a partnership with the King County Housing Authority or through the reservation of a set amount of generation for income-qualified customers.

Maximize Local Actions

Following the example of the City of San Francisco, King County could develop a local renewable electricity incentive program that specifically addresses equity impacts by providing greater incentive amounts to certain recipients. Program design, particularly one that incents low-income participation or green-collar workforce development could significantly improve the equitable distribution of the economic benefits of this action. Distinct equity impacts are not expected for a bioenergy production program or a net zero energy program (apart from the implications of facility siting decisions).

In San Francisco's GoSolarSF program, a base rebate is made available to any city resident installing solar, and additional incentive adders are provided to customers that qualify as low-income, that are located in designated environmental justice zip codes, or who utilize in-city labor for project construction. The income-based incentives are substantial in this program, and are currently set at $2.00/W, compared to a base incentive of $0.30/W.

Maximize Voluntary Actions

Generally, as voluntary programs are currently operated on an opt-in basis, these are assumed to have minimal equity impacts. Only customers that are willing to pay a premium for renewable electricity, as utility programs are currently structured, would incur costs.

If such a program were to be implemented on an opt-out basis, it is possible that equity impacts would be a concern in its development. While any customer would have the ability to decline to participate in the program, it would be critical to conduct an outreach program that effectively communicated the cost of participation and the process to opt out. Given the potentially significant reduction in carbon emissions from reduced fossil fuel generation, this program could have a positive health impact from better air quality, especially for communities in proximity to conventional facilities.

State Wide Price on Carbon Policy

A carbon policy would likely be implemented in a way that increased electricity costs unequally among all utility ratepayers. An increase to electricity rates would disproportionately impact utility customer classes (such as renters or residents with barriers to capital) that have reduced ability to reduce electricity costs by adopting energy efficiency measures. Moreover, price impacts are likely to differ by utility. Seattle City Light customers likely would not experience a substantial increase in rates as SCL's power mix would not be impacted severely by a policy to price carbon, while PSE customers likely would.

A more direct consequence of a carbon price, as it is expected to cause several coal power plant closures in the northwest, would be in the impact on the communities where these facilities are located. For example, the community of Colstrip, Montana, would be impacted by the accelerated closure of Colstrip units 3 and 4 that would be likely in a carbon pricing scenario. As a mitigation measure for these impacts, however, PSE's Settlement Agreement for the closure of Colstrip Power Plant sets aside $10M of funding for worker training and community transition.[38]

Depending on the specific formulation of a carbon policy, program revenues can be allocated for investment in clean electricity projects or for other carbon-reduction measures. While this is not accounted for in this scenario modeling exercise, local governments may adopt approaches to ensure positive equity outcomes in health and economic development. For example, reinvestment of carbon price revenues could create opportunities for a program design that addresses equity through reinvestment in communities most burdened by climate impacts.

Enact a 100% Renewable New Generation Policy

As with a carbon price proposal, a 100% Renewable New Generation policy may result in a small increase in electricity costs, dependent on the cost to build renewable energy plants. As in the carbon price policy, the costs may be shared unequally among all ratepayers, including differing based on utility (e.g. Seattle City Light customers likely would not see an increase, while PSE residential customers likely would).

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[38] Dawson, Raechel. "Bellevue-based Puget Sound Energy rate case settled." Bellevue Reporter. Dec. 2017. http://www.bellevuereporter.com/news/bellevue-based-puget-sound-energy-rate-case-settled/

A 100% Renewable New Generation policy has the potential to stimulate job creation in the construction and operations of new renewable electricity generation facilities. Equity considerations in policy design could ensure a just transition for communities serving existing fossil fuel facilities.

A long-term shift to renewable electricity generation has the potential to significantly improve air quality and associated health markers as the levels of carbon emissions reduce over time in the region.

6. CONCLUSION

A 90% renewable electricity goal, particularly within a timeframe as near as 2030, is an ambitious target for any jurisdiction, even considering the renewable resources present in Washington State. Of the four strategy bundles evaluated in this study, no single option is projected to achieve 90% renewable electricity by 2030. It is possible that state policy actions will be sufficient to meet this target in the long run, but not in a limited timeframe. However, this analysis concludes that it is possible for King County to meet its 90% renewable electricity target if the County and its partners take action on multiple fronts.

The strategies evaluated in this analysis range from relatively feasible steps that the County could take quickly, independently, and with high community visibility but that would have only a modest electricity impact, to those that would require collaboration with outside actors but that would have larger and more lasting potential for renewable electricity impact. As such, there is a direct trade-off between the types of strategies that are under County control and those that are expected to have a substantial impact on the county's energy mix. Meeting the 90% renewable electricity target by 2030 would require that King County swiftly pursues several strategies in parallel, some of which involve collaborating with state policy actors and with local utilities. These strategies include the following:

- Take direct action to dramatically increase in-county renewable electricity generation. These actions would include a combination of statutory powers (streamlining permitting and zoning, implementing a new construction solar mandate, etc.), lead-by-example investments (such as maximizing renewable electricity installations on County facilities, and leasing County lands for large renewable projects), and community-based actions (such as supporting group purchasing programs and providing direct incentives for renewable electricity generation). It is not expected that these local government actions will have a dramatic impact on the county power mix, but they will provide visibility, build momentum, and demonstrate the County's commitment to meet its renewable electricity goal. There are also opportunities to take equity and other non-energy goals into account in these actions, such as by targeting low-and-moderate income residents in the design of community-based programs.
- Partner with utilities to expand customer access to renewable energy. Utility customers in Washington State have relatively little choice in their source of electricity supply. The options that are available are typically offered through voluntary utility programs. By partnering with utilities to support and expand these programs, King County can leverage the demand of its residents and businesses into progress towards its renewable electricity goals, and provide much needed flexibility in its efforts to achieve a 90% renewable electricity mix.
- Work Strategically with State Policymakers to Implement High-Impact Policy Changes. This analysis demonstrates that action at the state level is necessary to meet renewable electricity goals for 2030 and establish the framework for further reductions in greenhouse gas emissions through increased generation by renewable systems. Both state-level policy actions evaluated in this study, a carbon price and a 100% Renewable New Generation policy, are expected to have significant impacts on the state and county electricity mix beyond the 2030 timeframe of this study. For the period ending

2030, a carbon price is a more impactful policy option. King County can engage with partners at the local government level, legislative and regulatory bodies at the state level, and utilities to develop policy that enables a transition to renewable generation resources.

- Incorporate equity considerations in development of state level or local policies. Partners and policymakers have the opportunity to be intentional about creating equitable access to the benefits of cleaner electricity supplies, including economic development and healthier communities.

In addition to impacts on power mix, these strategies are expected to have varying degrees of feasibility, as well as varying impacts on local economies, and varying cost and equity impacts. Table 25 below provides a summary of these factors across policy strategies.

Table 25. Summary of Feasibility and Impact of Renewable Electricity Policy Strategies

Scenario	Feasibility	Energy Impact	Scale of Economic Impact	Cost Impact	Equity Impact
Standard Package of Local Actions	**High feasibility,** policy actions can be done independently with relatively low barriers to implementation	**Very small** impact on county energy mix	**Local** economic impact	Relatively **high cost** compared to benefits	Opportunities for **positive local equity impacts**
Maximize Local Actions	**Medium feasibility,** policy actions can be done independently but with higher barriers to implementation	**Small** impact on county electricity mix	**Local** economic impact	Relatively **high cost** compared to benefits	Opportunities for **positive local equity impacts**
Maximize Voluntary Actions	**Medium feasibility,** dependent on utility collaboration but build on existing programs	**Medium** impact on electricity mix	**Regional** economic impact	Relatively **low cost** compared to benefits	**Little impact** on equity
Carbon Price Policy	**Somewhat feasible,** would require state policy action, but could leverage current state policy conversations	**Medium** short-term impact on electricity mix, with potential for large long-term change	**Regional** economic impact	Relatively **low cost** compared to benefits	Dependent on design and reinvestment of revenues.
100% Renewable New Generation Policy	**Somewhat feasible,** would require state policy action, but could leverage current state policy conversations	**Small** short-term impact on electricity mix, with potential for large long-term change	**Regional** economic impact	Relatively **low cost** compared to benefits	**Little impact** on equity

The conclusion of this analysis is that, to meet its ambitious renewable electricity target, the County would need to act swiftly on multiple pathways, as no single option is expected to be sufficient to meet the target. While state-level policy is projected to have a more significant impact, particularly beyond the 2030 timeline, local policy action items provide quick and high-visibility accomplishments that can build momentum for larger changes. This report outlines that, to meet its 90% by 2030 renewable electricity target, King County would need to pursue local policy and investments while also advocating for state level policy that supports increased renewable electricity development.

APPENDIX A. POLICY BARRIERS AND OPPORTUNITIES RESEARCH

This appendix provides detail on the results of the qualitative policy analysis described in Section 4. For each of the 39 policies or programs identified as potentially of interest in King County through stakeholder conversations, Cadmus assessed:

- Any prior policy efforts or relevant developments in King County or Washington State.
- The expected potential impact of a policy or program on the county electricity mix.
- The expected cost-effectiveness of a policy or program, both to the County and to non-County stakeholders.
- The feasibility of a policy or program, and the expected ease with which it could be implemented.
- The expected equity impact of a policy or program.
- Any notable non-energy benefits or costs of a policy or program.
- Any key barriers to the implementation of a policy or program.

A.1 RESEARCH PROCESS

The Project Team assessed a variety of potential policy pathways that King County could pursue, either alone or in collaboration with other organizations, to increase the county-wide penetration of renewable energy. The Project Team developed an initial set of roughly 20 strategies from a prior Cadmus report, *Pathways to 100: An Energy Supply Transformation Primer for U.S Cities*,[39] which documents local government policy approaches to higher levels of renewable energy. At a stakeholder workshop held in King County's Seattle offices on September 15, 2017, Cadmus presented this initial set of strategies for discussion and feedback to a range of government, utility, business, and non-profit stakeholders. Based on this discussion and other subsequent stakeholder feedback, Cadmus made additions, deletions, and revisions to its initial set of strategies and developed a list of 39 policies, programs, and other initiatives to investigate further.

The team then completed an extensive benchmarking research process to qualitatively define the potential opportunity for and barriers to each strategy. This involved consulting regional installation databases, integrated resource plans, and other independent studies where available. Desk research was complemented by stakeholder interviews coordinated with King County to discuss barriers, potential gaps, and additional opportunities for continued renewable energy penetration.

The 39 strategies assessed in this analysis were grouped into five categories, which are differentiated by the ability of the County to act directly or in tandem with partners to implement those strategies. These are:

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[39] Available at: https://cadmusgroup.com/papers-reports/pathways-to-100-an-energy-supply-transformation-primer-for-u-s-cities/

- Use City or County Powers: King County and its partner cities can implement certain policies and strategies directly using the statutorily enabled authority of a local government, such as streamlining permitting and zoning regulations or adjusting the elements of building code that are under municipal control. In general, these strategies allow for relatively swift action, though the impact on increasing the share of renewables in the county's electricity mix may be limited.
- Create or Expand Local Initiatives: Beyond direct legal and regulatory powers, county and local governments can also have direct local impacts by creating or supporting community programs or other initiatives in partnership with local business or community organizations. Given that many initiatives already exist in King County, some of these strategies can be implemented quickly, but the additional impact of County support may be limited.
- Partner with Local Utilities: These strategies involve county-level cooperation with utilities to facilitate access to renewables in support of the 90% renewable electricity goal. Examples include encouraging the implementation of a utility-owned rooftop solar program or the expansion of renewable energy purchasing options for customers.
- Partner on State Action: Join with cities, utilities, and other parties to pursue state energy policies and investments that lead to higher building efficiency, encourage greater utility investment in renewable electricity production and distribution, and incent local government and customer investment in renewable electricity.
- Gain Direct Control over Electricity Mix: This category includes strategies that give the County direct influence over the fuel mix, such as the development of a community choice aggregation program. It covers strategies that have high impact potential, but are generally more costly and difficult to implement.

A.2 SUMMARY OF POLICY ANALYSIS

Table 26 below summarizes the results of the qualitative policy analysis conducted for each of the 39 potential strategies. A fuller description of the opportunities and barriers research that informed this summary table is included in Appendix A.

In the table below, each strategy is rated qualitatively (from Low to High) on several criteria:

- The potential impact that a policy is expected to have on the county-wide electricity mix. For example, increasing local distributed generation tends to have a minimal impact on the electricity mix, while major state-level policy actions would have a higher impact.
- An indication of the relative cost-effectiveness of a given strategy to King County. Strategies that require large investments, for instance, would have a low or medium rating, while strategies that involve a simple process or minor policy adjustment would be rated as high.
- The relative cost-effectiveness of a given strategy to non-County stakeholders (such as distributed generation system owners, utility ratepayers, etc.).
- The expected feasibility of implementing each strategy. Feasibility includes political and logistical considerations. For example, major state-level policy actions were generally lower-feasibility than straightforward changes in local policy.

As discussed in Section 4, a subset of strategies was selected for inclusion in the scenario modeling exercise. These strategies are identified in the table below.

Table 26 below provides a high-level summary of the results of this policy review, and indicates the policies and programs that were selected for inclusion in the scenario modeling exercise. A more detailed overview of each individual policy follows.

Table 26. Summary of Review of Potential Renewable Electricity Policies and Strategies.

Category	Strategy	Potential Impact Rating	County Cost-Effectiveness Rating	Stakeholder Cost-Effectiveness Rating	Feasibility Rating	Included in Scenario Models
Use of City or County Powers	Permitting Improvements	Low	High	High	High	Yes
	Renewable Energy Zoning Ordinance	Low	High	High	Medium-High	Yes
	Solar Ready Guidelines	Low	High	High	High	Yes
	Net Zero Energy Building Codes	Low-Medium	High	Low-Medium	Low-Medium	Yes
	Mandates for Local DG Production	Low-Medium	High	Low-Medium	Medium	Yes
	District Electricity Systems	Low	Medium	Low	Low	No
	Zoning Limits on New Fossil Fuel Facilities	Low	High	Medium	Low-Medium	No
	County-Sited Renewable Electricity Projects	Low	Medium	Medium	Medium	Yes
	Lease Public Lands for Renewable Energy	Low-Medium	Medium	Medium-High	Medium	Yes
Create or Expand Local Initiatives	Support Community Solar Programs	Low	Medium	Medium-High	Medium	Yes
	Support Renewable Electricity Group Purchasing Programs	Low-Medium	Medium-High	Medium-High	High	Yes
	Local Incentives for Renewable Energy	Low-Medium	Low	High	Low-Medium	Yes
	Develop Local Financing Programs	Low	Low	High	Low	No
	Expand Bioenergy Production	Low-Medium	Medium	Medium	Medium	Yes
	Establish Virtual PPA Purchasing Programs	Medium	High	Medium	Low-Medium	No
	Form Government-Business Community Collaborative	N/A	Medium-High	Medium-High	Low-Medium	Yes[A]
Partner with Local Utilities	Promote Expanded REC Purchases	Medium	Medium-High	Medium	Medium-High	Yes
	Streamline Interconnection Processes	Low	High	High	Medium-High	No
	Expand Utility Green Tariff Program	Low-Medium	High	Medium	Medium-High	Yes
	Enact County-Wide Opt-Out Utility Green Energy Program	Medium	Medium	Medium	Low	No
	Enable Competitive Retail Supply for Renewables	Low-Medium	High	Medium	Low	No

Category	Strategy	Potential Impact Rating	County Cost-Effectiveness Rating	Stakeholder Cost-Effectiveness Rating	Feasibility Rating	Included in Scenario Models
Partner with Local Utilities (cont'd)	Establish Utility-Owned Rooftop Solar Program	Low	High	Low-Medium	Low	No
	Establish On-Bill Repayment or Financing Program	Low	High	High	Medium	Yes
	Establish Formal City-Utility Partnership	N/A	High	High	Medium-High	Yes[A]
Partner on State-Level Action	Raise NEM System Size Limit	Low-Medium	High	Medium	Low-Medium	No
	Raise NEM Program Cap	Low	High	Medium	Low-Medium	No
	Allow for Virtual Net Energy Metering	Low-Medium	High	Medium	Low-Medium	No
	Allow for Third-Party Ownership	Low-Medium	High	Medium-High	Low	No
	Enable PACE financing	Low	Medium	Medium-High	Low	No
	Increase State Renewable Portfolio Standard	High	High	Low-Medium	Low	No
	Establish a Carbon Price	High	High	Low-Medium	Medium	Yes
	State-Level Clean Power Plan	Medium-High	Medium	Low-Medium	Low	No
	Re-fund State Commerce Grants	Low-Medium	High	Medium	High	No[B]
	Re-fund State Clean Energy Fund	Low-Medium	High	Medium	High	No[B]
	Establish a 100% Renewable New Generation Policy	Medium-High	High	Low-Medium	Low-Medium	Yes
	Adjust Utility Procurement Guidance	Medium	High	Medium	Low-Medium	No
Gain Direct County Control Over Energy Mix	Form a Municipal Utility or Public Utility District	High	Low	Low	Low	No
	Form a Community Choice Aggregation Program	High	Low-Medium	Low	Low	No
	Form a Community Empowerment Program	Medium-High	Low-Medium	Medium	Low	No

[A] These strategies were determined to be beneficial for the County to pursue, but were not modeled quantitatively.

[B] It was determined that these strategies were likely to be implemented under current state funding plans.

A.3 POLICY DETAIL: USE OF CITY AND COUNTY POWERS

A.3.1 Permitting Improvements

Strategy Description: Streamline local permitting practices to enable faster and more affordable in-county renewable electricity development. Policy is expected to primarily impact local solar.

Table 27. Policy Detail; Streamline Distributed Generation Permitting Processes

Topic	Research and Analysis Highlights
Precedent in King County	There have been several programs to promote solar permitting best practices region-wide, several led by Spark Northwest through US DOE SunShot programs. There is still an opportunity for alignment across jurisdictions (inconsistency in local jurisdictions requiring or not requiring building permit, for example).
Potential Scale of Impact	**Low** - Strategy largely restricted to solar energy. Residential permitting is not viewed as a major barrier by stakeholders. As the state requires an electrical permit, there are limits to the ability to streamline these processes. Commercial solar permitting may have opportunities for improvement, but scale of that market is currently limited.
Cost Effectiveness	**For County: High**; **For Stakeholders: High** - Requires no major investments on the part of any stakeholder. Could even save costs over time as processes are streamlined.
Feasibility & Expediency	**High** – Ongoing efforts to coordinate and improve permitting and related municipal processes.
Equity Impacts	Varies – reduces barriers for all customers, but low- to moderate-income customers may face additional barriers to solar.
Additional Benefits or Costs	Local electricity production.
Key Barriers	No major barriers.
Analysis Conclusion	Included in standard package of local actions as a highly feasible best practice, despite small expected impacts.

A.3.2 Renewable Electricity Zoning Ordinance

Strategy Description: Adjust local zoning ordinances to reduce barriers to and explicitly encourage renewable electricity development. Policy is expected to primarily impact local solar.

Table 28. Policy Detail; Streamline Distributed Generation Zoning Processes

Topic	Research and Analysis Highlights
Precedent in King County	Spark Northwest has led numerous efforts through US DOE SunShot programs, focusing on solar. Solar considered an allowable secondary use by right in some jurisdictions, with opportunity to expand to other local jurisdictions.
Potential Scale of Impact	**Low -** Wide but not necessarily deep impacts. Stakeholders do not consider zoning to be a major barrier locally.
Cost Effectiveness	**For County: High**; **For Stakeholders: High -** No major costs beyond normal process of zoning updates.
Feasibility & Expediency	**Medium-High** – Generally feasible but timing is in question. A full zoning update could occur on a multi-year cycle; though updating limited parts of it could be much faster, roughly 6 months to a year.
Equity Impacts	Varies – reduces barriers for all customers, but low- to moderate-income customers may face additional barriers to solar. Zoning effects on placement can have equity impacts, but likely to be neutral.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Time and political will.
Analysis Conclusion	Included in standard package of local actions as a highly feasible best practice, despite small expected impacts.

A.3.3 Solar Ready Guidelines

Strategy Description: Encourage or require new buildings to be built in a way that accommodates future solar installations.

Table 29. Policy Detail; Adopt Solar-Ready Guidelines

Topic	Research and Analysis Highlights
Precedent in King County	The State Building Code requirements must be followed by all jurisdictions; However, local jurisdictions can apply for amendments to the local code, with an option (Appendix U) requiring new construction to be solar-ready. This option has been adopted by Issaquah, for example. Seattle required that new commercial construction up to 20 stories include a designated area that is designed for the installation of future solar projects.
Potential Scale of Impact	**Low -** Limited to rooftop solar, and to new construction market.
Cost Effectiveness	**For County: High**; **For Stakeholders: High -** No major costs. Expectation that incorporating plan for solar into building design would not add substantially to buildings costs, and would dramatically lower future solar installation costs.
Feasibility & Expediency	**High** – Implementation is feasible and has precedent, though the State Building Code Council must approve or deny all city or County code amendments.
Equity Impacts	Appears neutral.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Potential political difficulty in implementing as a mandate.
Analysis Conclusion	Included in standard package of local actions as a highly feasible best practice, despite small expected impacts.

A.3.4 Net Zero Energy Building Codes

Strategy Description: Require buildings to be net-zero-energy in some or all cases. This is assumed to apply to commercial and large multifamily new construction given local control over the commercial building code.

Table 30. Policy Detail; Adopt Net Zero Energy Building Codes

Topic	Research and Analysis Highlights
Precedent in King County	The State Energy Code makes solar one of eight options for attaining building energy performance minimums in new commercial buildings during construction, but does have specific requirements for Zero Net Energy Buildings. In Washington, the residential building code is controlled by the state government.
Potential Scale of Impact	**Low-Medium** - Building codes will only apply to new or renovated buildings, but could have significant impact if expanded broadly over time.
Cost Effectiveness	**For County: High; For Stakeholders: Low-Medium –** Policy would increase construction costs for building owners, partially offset by operational savings. County would incur limited costs.
Feasibility & Expediency	**Low-Medium** – Building codes are updated on a multi-year cycle. A building code amendment requiring net zero energy building use would be aggressive and likely encounter resistance.
Equity Impacts	Neutral or potentially negative if compliance is disproportionately difficult for certain categories of building of building owner.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Lack of consistent evaluation and valuation processes, inability to attract investment to achieve economies of scale, and aversion to change on part of builders and contractors.
Analysis Conclusion	Include in analysis in a scenario maximizing local action. Expected to face difficulty in implementation, but to be have relatively high impact compared to other local actions.

A.3.5 Mandates for Local Renewable Electricity Production

Strategy Description: Require renewable electricity development in certain cases, such as new construction.

Table 31. Policy Detail; Establish Mandates for On-Site Renewable Electricity Production

Topic	Research and Analysis Highlights
Precedent in King County	In addition to a solar ready requirement, the Seattle Energy Code requires that new commercial (>5,000 sq.ft.) and multi-family (4+ stories, >5,000 sq.ft.) construction include a small renewable energy project at the time of construction.
Potential Scale of Impact	**Low-Medium –** Limited to new construction, but impacts would be locked in and scale over time.
Cost Effectiveness	**For County: High**; **For Stakeholders: Low-Medium** - County would incur limited costs, but depending on specific requirements may be onerous for building owners.
Feasibility & Expediency	**Medium** – Depends on political will and process.
Equity Impacts	Neutral or potentially negative if compliance is disproportionately difficult for certain categories of building of building owner.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Likely opposition from building community due to cost and nature of mandate.
Analysis Conclusion	Included in standard package of local actions given the direct precedent in Seattle.

A.3.6 Encourage District Electricity Systems (Microgrids)

Strategy Description: Encourage and support the increased use of district energy systems through the combination of the city's planning and convening functions. As this study is limited to renewable electricity options, this analysis is limited to microgrids, rather than thermal district energy projects.

Table 32. Policy Detail; Encourage District Energy Systems

Topic	Research and Analysis Highlights
Precedent in King County	Seattle City Light recently won a grant to develop a microgrid at a local designated emergency shelter. It will include a utility-scale battery system, solar panels, and an emergency generator.
Potential Scale of Impact	**Low** - Microgrids will only accomplish renewable electricity objectives if the renewable electricity mix of the microgrid exceeds that of the replaced utility supply. If they operated with renewable resources, microgrids can provide significant emissions reductions in local areas. However, broad deployment outside of campus settings (e.g. universities, hospitals, etc.) may be practically and politically difficult.
Cost Effectiveness	**For County: Medium**; **For Stakeholders: Low** - County costs would be presumably low and restricted to staff time, but the cost to microgrid developers would be high and may require grant funding.
Feasibility & Expediency	**Low** – Microgrid development in developed areas requires a significant amount of planning, stakeholder coordination, and development of physical infrastructure.
Equity Impacts	Neutral
Additional Benefits or Costs	Benefits of resilience; Local electricity production
Key Barriers	Significant cost barriers and stakeholder buy-in required.
Analysis Conclusion	Excluded from policy scenarios given cost, degree of difficulty, and limited county-wide electricity impact.

A.3.7 Ban New Fossil Fuel Facilities

Strategy Description: Use the zoning code to prohibit the development of new fossil fuel power plants in King County. Optionally, the zoning code could also be used to limit coal mining in King County. But as this would not have a direct impact on King County's power mix, that strategy is not considered here.

Table 33. Policy Detail; Limit Construction of New Fossil Fuel Facilities

Topic	Research and Analysis Highlights
Precedent in King County	None.
Potential Scale of Impact	**Low** - Very little of King County's electricity consumption is generated from in-county facilities. Of the 10.6 GW of utility-scale generating capacity installed in Washington state and tracked by the US Energy Information Administration, only 25 MW is located in King County. Of this local utility-scale generation, only the University of Washington Power Plant utilizes fossil fuels.
Cost Effectiveness	**For County: High; For Stakeholders: Medium -** County would incur limited staff costs. If the current University of Washington facility is unaffected, there would be no known impacts on other stakeholders as there are no current plans for fossil fuel development in King County.
Feasibility & Expediency	**Low-Medium** – As there is little precedent for using the zoning code to this end, it is unknown how onerous the process would be. Zoning codes are updated on multi-year cycle.
Equity Impacts	Likely Neutral. Could potentially negatively impact industrial workers.
Additional Benefits or Costs	Could be detrimental to resilience and grid management if used to limit possibilities for back-up generation.
Key Barriers	Potential opposition from system owners and utilities (for grid management reasons), significant legal uncertainty.
Analysis Conclusion	Excluded as the policy is not expected to have an immediate impact on power mix.

A.3.8 Site Renewable Electricity Projects on County Facilities

Strategy Description: Install renewable resources at County facilities wherever feasible.

Table 34. Policy Detail; Increase County-Sited Renewable Electricity Projects

Topic	Research and Analysis Highlights
Precedent in King County	King County has previously developed 330 kW of solar projects across eight facilities. The County has a target of fully serving county government load with renewable energy, and is participating in the PSE Green Direct program to help in achieving this.
Potential Scale of Impact	**Low -** Municipal facilities may be limited in on-site space capacity to host renewable electricity projects. County facilities (even including city facilities as well) account for a small percentage of King County building stock.
Cost Effectiveness	**For County: Medium**; **For Stakeholders: Medium** - Significant upfront cost, but savings over time.
Feasibility & Expediency	**Medium** – Would build upon current County practices, but expected to take time to scale.
Equity Impacts	Neutral.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Available space and site suitability, cost.
Analysis Conclusion	Included in standard package of local actions as a means for the County and its city partners to lead by example.

A.3.9 Lease Public Lands for Renewable Energy

Strategy Description: Work with utilities and developers to develop large-scale renewable electricity projects at county-owned lands, potentially with attractive leasing terms. Could be similar to Seattle's commitment to dedicate surplus city-owned properties for affordable housing.

Table 35. Policy Detail; Lease Public Lands for Renewable Electricity Projects

Topic	Research and Analysis Highlights
Precedent in King County	No direct precedent. City of Seattle and King County have recently taken steps towards prioritizing affordable housing in the land use decisions for surplus properties.
Potential Scale of Impact	**Low-Medium** - Offering low-cost land leases to developers may be attractive for larger in-county renewable electricity facilities. However, even with lower-cost leases, lease prices and generation potential (especially for solar) may be more attractive outside of county. Expected that only a small number of sites would both be good candidates for renewable electricity generation and free from competing uses.
Cost Effectiveness	**For County: Medium; For Stakeholders: Medium-High** - County would receive revenue stream from lease, but may be below-market and may preclude alternate land uses. Developers would have access to below-market land leases.
Feasibility & Expediency	**Medium** – Would require formal process to surplus land or offer land leases on competitive basis.
Equity Impacts	Neutral.
Additional Benefits or Costs	Local electricity production; Could be detrimental to competing land use priorities
Key Barriers	Conflicts over use of available land parcels for renewable electricity or other priorities.
Analysis Conclusion	Included in standard package of local actions as a means for the County and its city partners to lead by example.

A.4 POLICY DETAIL: CREATE OR EXPAND LOCAL INITIATIVES

A.4.1 Directly Support Community Solar Projects

Strategy Description: Act as an organizer, site host, or anchor customer in a community solar project. Under current regulations, the most beneficial role for King County would most likely be as a site host (offering land, potentially below market value) for project development, and as a convener (supporting the enrollment and marketing process). The County could also partner with the King County Housing Authority to organize a program directly.

Table 36. Policy Detail; Directly Support Community Solar Projects

Topic	Research and Analysis Highlights
Precedent in King County	Current regulations allow utilities, non-profits or housing authorities to coordinate community solar projects. Unlike other states with virtual NEM rules, community solar participants do not receive bill credits for electricity produced, but instead benefit through tax credits and the WA production incentive. There are numerous legacy community solar projects, including five operated by Seattle City Light. As of July 1, 2017, the Washington State Production Incentive for Community Solar (and other forms of renewable energy) was amended to allow for larger projects (up to 1 MW) with lower, but guaranteed, incentives for an 8-year period. Rulemaking is underway at the UTC and with WSU Extension, which is the program administrator.
Potential Scale of Impact	**Low** - it is unlikely that community solar projects in the county would amount to a significant amount of the county's generation portfolio.
Cost Effectiveness	**For County: Medium; For Stakeholders: Medium-High** - Could provide opportunities for community members to receive tax and state incentives while providing appreciable benefits to non-profits or other program organizers.
Feasibility & Expediency	**Medium**– Policy framework and projects already exist; but detailed regulations still in development.
Equity Impacts	Potential equity benefits depending on program structure (e.g. for projects that the County supports, could require a set percentage of LMI participation). Direct partnerships with King County Housing Authority would result in equity benefits.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Potential land use and cost barriers to large-scale solar development in King County, regulatory barriers on participation.
Analysis Conclusion	Included in standard package of local actions as a means for the County to encourage renewable electricity through community programs.

A.4.2 Expand Distributed Electricity Group Purchasing Programs

Strategy Description: Increase scale of Solarize Washington and related community-based renewable electricity installation programs.

Table 37. Policy Detail; Expand Distributed Electricity Group Purchasing Programs

Topic	Research and Analysis Highlights
Precedent in King County	Spark Northwest has a history of conducting Solarize campaigns throughout King County, often with the funding and support of local utilities. There are no active Solarize campaigns in the county currently. Elsewhere in the country (such as MA, NY, and CT), Solarize programs are supported with consistent state government funding and resources.
Potential Scale of Impact	**Low-Medium** – Solarize and similar programs have been effective tools for local solar market growth, but overall impact on county-wide electricity mix expected to be low.
Cost Effectiveness	**For County: Medium-High**; **For Stakeholders: Medium-High** - Solarize programs can be deployed as a relatively low-cost means of expanding local renewable electricity purchases, while creating opportunities for savings among residents.
Feasibility & Expediency	**High** – Programs are already well established and can be readily expanded.
Equity Impacts	Potentially positive: some group purchasing program designs are tailored to apply to low income families
Additional Benefits or Costs	Local electricity production.
Key Barriers	Minimal barriers to implementation, some funding requirements.
Analysis Conclusion	Included in standard package of local actions as a means for the County to encourage renewable electricity through community programs.

A.4.3 Establish Local Incentives for Renewable Energy

Strategy Description: Establish a direct incentive for the development of renewable electricity project in King County, paid out of County funds collected by the County. As the providers of funds, the County could incorporate program design aspects that target additional equity or other benefits.

Table 38. Policy Detail; Establish Local Incentives for Renewable Energy

Topic	Research and Analysis Highlights
Precedent in King County	None in King County. Primary relevant example is the GoSolarSF program in San Francisco. This program offers a base incentive for local solar installations, and adders for projects installed by low-income residents, within designated environmental justice zip codes, or that utilize in-city labor.
Potential Scale of Impact	**Low-Medium -** Impact limited by availability of funds. Go Solar SF supported more than 10 MW of installed solar from 2008 to 2014.
Cost Effectiveness	**For County: Low; For Stakeholders: High -** Would be a pure cost to County, and a pure incentive to recipients. County dollars may also be spent on free riders (incentive recipients that would have installed solar even without this funding).
Feasibility & Expediency	**Low-Medium** – Programs can be implemented directly by the County, but requires funding allocation (the SF program was funded via a special ordinance).
Equity Impacts	Positive, particularly if program is implemented in manner that targets LMI participation (as San Francisco's has been).
Additional Benefits or Costs	Local electricity production.
Key Barriers	Availability and use of funds.
Analysis Conclusion	Given potential local impacts but need for funding appropriation, include in Maximum Local Actions scenario.

A.4.4 Develop Local Financing Programs for Renewable Energy

Strategy Description: Work with local lenders to offer low-cost financing for renewable electricity projects

Table 39. Policy Detail; Develop Local Financing Programs for Renewable Energy

Topic	Research and Analysis Highlights
Precedent in King County	There are several similar financing programs in and around King County. Through King County's Green Community Initiative, the Washington State Housing Finance Commission provides financing to community groups, nonprofit organizations and businesses for projects that conserve energy, water, and promote environmental sustainability. Clark County Public Utilities offers financing of up to $30,000 to its customers for the purchase and installation of residential solar equipment. Through a grant from the State Clean Energy Fund, Puget Sound Cooperative Credit Union offers a "Sustainable Solar" loan as low as 3.5% for up to 20 years. Elsewhere in the county, several states have developed special financing programs for customer-sited renewable electricity by working with lenders to reduce interest rates (such as the Massachusetts Solar Loan).
Potential Scale of Impact	**Low** - Low cost financing can be a significant benefit to customers, particularly LMI customers, but this it is unclear whether County efforts would be far superior to current offerings.
Cost Effectiveness	**For County: Low; For Stakeholders: High** - Public sector incurs cost of any interest rate buy-downs; however, customers would benefit from this.
Feasibility & Expediency	**Low** – Program involves many stakeholders and complicated partnership with lenders. May also require allocation of funds.
Equity Impacts	Positive, particularly if program is implemented in manner that targets LMI participation or residents with low credit scores.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Time to set-up, availability of funding, and complexity (reference program in Massachusetts is state-run).
Analysis Conclusion	Excluded, as it is not clear that a County-supported program would be an improvement over current market options.

A.4.5 Expand Bioenergy Production

Strategy Description: Develop program that diverts organic waste to energy projects. This could involve compost from the city composting program being considered for biogas, or the prioritization of electricity generation in the use of county biogas production.

Table 40. Policy Detail; Expand Bioenergy Production

Topic	Research and Analysis Highlights
Precedent in King County	King County currently produces biogas at the West Point, South Plant, and Brightwater treatment plants. The Cedar Hills Landfill gas-to-energy facility generates renewable energy from landfill gas produced by decomposing organic material. Seattle City Light has announced a contract for new, renewable energy from landfill as power plant at Columbia Ridge Landfill in Oregon.
Potential Scale of Impact	**Low** - There are already multiple bioenergy projects in place, but King County could take steps to broaden the scale of these projects or prioritize electricity generation over other uses of biogas (but would likely result in low percentage of King County's electricity needs).
Cost Effectiveness	**For County: Medium**; **For Stakeholders: Medium** - Low costs incurred by County. High costs associated with installing necessary equipment, but potential for long term payback through electricity purchases and diverted waste.
Feasibility & Expediency	**Medium** – Could require additional equipment or construction of infrastructure
Equity Impacts	Neutral.
Additional Benefits or Costs	Could be detrimental to competing policy goals (i.e. use of waste for compost and the use of renewable natural gas for thermal applications).
Key Barriers	High initial costs.
Analysis Conclusion	Include in Maximize Local Actions scenario, as this would be a pathway for the county to maximize local renewable electricity generation, though it would come at the cost of a competing productive use of biogas.

A.4.6 Establish Virtual PPA-Based Purchasing Program

Strategy Description: Organize a renewable electricity purchasing program among government, business, and residents using Virtual PPAs. In a Virtual PPA, a customer will sign a contract-for-differences (CfD) with a renewable electricity provider and obtain ownership of environmental attributes. The power itself is sold to the market, and not to the customer, but the customer's CfD provides a price guarantee to the developer that allows construction to move forward.

Table 41. Policy Detail; Establish Virtual PPA-based Purchasing Program

Topic	Research and Analysis Highlights
Precedent in King County	Virtual PPAs are an increasingly popular option among corporations and other large consumers in regulated utility markets that lack options to purchase renewable electricity directly. There is no prior example of a government-organized Virtual PPA purchasing program by residents. There is some precedent of private power purchasers in Washington State utilizing virtual PPAs.
Potential Scale of Impact	**Medium** – The impact would be limited by the interest in residents and businesses in participating.
Cost Effectiveness	**For County: High; For Stakeholders: Medium -** County would only incur marketing and staff costs to support current programs, customer bill becomes more complex, with potential for added or saved costs.
Feasibility & Expediency	**Low-Medium** – Significant time to educate stakeholders and design structure, given the novelty of the concept.
Equity Impacts	Neutral.
Additional Benefits or Costs	
Key Barriers	The novelty of this agreement and the complexity of the contracting introduces risk for a County program.
Analysis Conclusion	Excluded from scenarios given King County's preference to pursue strategies that entailed physical power purchases rather than Virtual PPAs.

A.4.7 Collaboration with Business Community to Develop Programs

Strategy Description: This strategy would involve partnering closely with businesses to establish an alliance of support for a variety of renewable electricity programs. This is largely a vehicle for advancing other strategies. Elsewhere, local philanthropies have acted as conveners for such collaborations.

Table 42. Policy Detail; Form Collaboration with Business Community

Topic	Research and Analysis Highlights
Precedent in King County	No formal partnerships in King County. Nationally, the Green Ribbon Committee in Boston is an example of a city-business collaborative (funded by philanthropy) to pursue joint sustainability interests.
Potential Scale of Impact	N/A – This strategy does not lead directly to renewable electricity development in itself, but can be useful in advancing other policies and strategies.
Cost Effectiveness	**For County: Medium-High**; **For Stakeholders: Medium-High** - Minimal resources required to form partnership, but significant resources may be demanded depending on the programs that result.
Feasibility & Expediency	**Low-Medium** – Informal collaboration is quick to initiate, with formal structures taking more time and resources.
Equity Impacts	Neutral, but depending on resulting programs
Additional Benefits or Costs	
Key Barriers	Business reluctance to take political positions, obtaining funding for staffing and operations.
Analysis Conclusion	Included as a suggested action item for King County, but not included in the scenario analysis given lack of direct impact on electricity mix.

A.5 POLICY DETAIL: PARTNER WITH LOCAL UTILITIES

A.5.1 Expand REC Purchases Among County Residents and Businesses

Strategy Description: Seek to expand participation in REC-based purchasing programs, such as SCL's Green Up, PSE's Green Power Program, or non-utility efforts. The county would collaborate with utilities to encourage participation in these programs.

Table 43. Policy Detail; Promote Expanded REC Purchases

Topic	Research and Analysis Highlights
Precedent in King County	There are several programs currently available (the SCL Green Up program; and the PSE Green Power and Solar Choice programs). Seattle City Light's Green Up program had 13,000 participants at end of 2016 and PSE's Green Power has 43,000 participants. All programs source RECs from regional northwest renewable electricity projects.
Potential Scale of Impact	**Medium** - Potential room for growth. Roughly 4% (~40,000) of PSE customers participate in Green Power Program, and leading green pricing programs nationwide have higher participation rates.
Cost Effectiveness	**For County: Medium-High; For Stakeholders: Medium -** County would only incur marketing and staff costs to support current programs, customers see simple (but relatively affordable) increase in utility bills.
Feasibility & Expediency	**Medium-High** – There are existing programs to build upon, but impacts may be limited by willingness to pay premiums for energy. Utilities would likely be willing partners in such a program.
Equity Impacts	Neutral – participation is voluntary but requires participants to pay a premium on energy bills.
Additional Benefits or Costs	
Key Barriers	There is a perception among some stakeholders that RECs are a less desirable renewable energy purchasing option than physical power purchases.
Analysis Conclusion	Included given King County's interest in a voluntary program scenario.

A.5.2 Interconnection improvements

Strategy Description: Simplify utility interconnection procedures for renewable electricity installations. This policy is particularly helpful for distributed generation.

Table 44. Policy Detail; Interconnection Improvements

Topic	Research and Analysis Highlights
Precedent in King County	Stakeholder consider PSE and SCL to have relatively streamlined and simple interconnection processes.
Potential Scale of Impact	**Low** - Interconnection barriers have not been cited as major issue in King County.
Cost Effectiveness	**For County: High; For Stakeholders: High** - Low costs incurred by County. Developer costs reduce due to streamlined process. Initial utility costs offset by long term operational savings.
Feasibility & Expediency	**Medium-High** – Would be incremental improvements on existing process.
Equity Impacts	Neutral
Additional Benefits or Costs	
Key Barriers	No major barriers, but limits to further improvement.
Analysis Conclusion	Excluded as stakeholders have not expressed a need for significant improvement in this area. Would not be a priority are for County-utility collaboration.

A.5.3 Expanded Utility Green Tariff Program

Strategy Description: Engage utilities to expand and build on PSE's existing Green Direct program, which offers customers the opportunity to purchase directly from renewable electricity providers at long-term fixed prices, facilitated by a utility tariff.

Table 45. Policy Detail; Expanded Utility Green Tariff

Topic	Research and Analysis Highlights
Precedent in King County	PSE offers Green Direct program, the first phase of which was quickly enrolled. This program is only open to large energy consumers and local governments. King County participates in this program.
Potential Scale of Impact	**Low-Medium** - The pilot was limited to an aggregate 75 average MW, but could be expanded if there is adequate demand and stakeholder interest. Growth would depend on voluntary action by energy consumers.
Cost Effectiveness	**For County: High**; **For Stakeholders: Medium –** Low costs incurred by County to expand program. Value proposition to consumers is uncertain and will depend on future power prices.
Feasibility & Expediency	**Medium-High** – There is stakeholder interest, in incrementally expanding existing the program. It may not be feasible to expand the program beyond large energy consumers, however.
Equity Impacts	Neutral
Additional Benefits or Costs	
Key Barriers	Capacity of the utility to manage an expanded program, concern over a potential expansion of the program to smaller and less sophisticated purchasers (residents and small businesses).
Analysis Conclusion	Included given King County's interest in a voluntary program scenario.

A.5.4 Enact County-Wide Opt-Out Utility Green Energy Program

Strategy Description: Automatically enroll customers in a Green Direct or Green Power program, with an opt-out option.

Table 46. Policy Detail; County-Wide Opt-Out Green Tariff

Topic	Research and Analysis Highlights
Precedent in King County	There is no precedent of an opt-out utility green pricing program. Most Community Choice Aggregation Programs (discussed below), however, are conducted on an opt-out basis.
Potential Scale of Impact	**Medium** - Including all eligible customers in Green Direct would greatly expand renewable energy use within the county, though it is unclear what the resulting opt-out rate would be.
Cost Effectiveness	**For County: Medium**; **For Stakeholders: Medium** – The County may need to support administration of a program, administrative costs incurred by utility, and participants likely to pay slightly increased rates for energy.
Feasibility & Expediency	**Low** – The novelty of an opt-out program is likely to present barriers and invite regulatory scrutiny.
Equity Impacts	Potentially negative if residents are not given adequate information to opt out.
Additional Benefits or Costs	
Key Barriers	Opposition from customers, utilities, and/or regulators; concern over residents' awareness of opt-out option.
Analysis Conclusion	Excluded from primary modeling scenarios, but modeled as a standalone model variant given stakeholder interest.

A.5.5 Enable competitive retail supply for renewable energy

Strategy Description: Enact state law enabling competitive retail choice for all or some customers who would wish to purchase power directly from renewable energy providers.

Table 47. Policy Detail; Competitive Retail Energy Supply

Topic	Research and Analysis Highlights
Precedent in King County	Washington's electricity market is traditionally regulated, meaning that customers are not able to choose their power provider. In roughly half the country, markets are deregulated and customer retail choice is allowed. In some states without broad retail electric choice (such as California and Michigan), specific programs have been put in place that allow some consumers to purchase retail power on a competitive basis, which some customers have used as an opportunity to purchase renewable electricity directly. In Washington, the UTC recently approved a tariff between PSE and Microsoft which provided Microsoft the ability to competitively procure renewable electricity on a retail basis – UTC's approval was specifically positioned as not setting a precedent for future customers, however.
Potential Scale of Impact	**Low-Medium** - Adoption would be up to customer preference and action, though the agreement with Microsoft is unique given the potential benefits to the community and isn't likely to be replicable with other customers.
Cost Effectiveness	**For County: High; For Stakeholders: Medium** - Low costs incurred by County, administrative costs incurred by utility, cost competitive prices for customers
Feasibility & Expediency	**Low** – The PSE/Microsoft tariff was explicitly meant to be non-precedent-setting. It is likely that any future proposal would invite utility opposition and regulatory scrutiny.
Equity Impacts	Neutral
Additional Benefits or Costs	
Key Barriers	Complexity and resistance from utilities and regulators.
Analysis Conclusion	Excluded as this policy seems to be less politically viable than other options.

A.5.6 Utility-Owned Rooftop Solar Program

Strategy Description: Engage utility to implement utility-owned rooftop solar program. This would impact distributed solar markets by allowing customers to install solar without bearing the costs.

Table 48. Policy Detail; Utility-Owned Rooftop Solar

Topic	Research and Analysis Highlights
Precedent in King County	None in King County. Several utilities nationwide have implemented a similar program (such as APS and Tucson Energy in Arizona, CPS Energy in Texas, and LADWP in California).
Potential Scale of Impact	**Low** - Will expand solar benefits to customers who have been excluded by high costs, but would have little impact on the county power mix.
Cost Effectiveness	**For County: High; For Stakeholders: Low-Medium –** The County would not face major costs. The utility would incur upfront costs and rooftop solar is among the least cost-effective options available to the utility. Program participants would receive modest benefits from hosting projects.
Feasibility & Expediency	**Low** – Utility will need to get approval for a program and will then need to design the program, recruit customers, and update billing process
Equity Impacts	Positive: A likely outcome of such a program would be to allow lower-income residents to participate in the solar market.
Additional Benefits or Costs	
Key Barriers	Utility opposition and concerns about cost of utility-owned resources.
Analysis Conclusion	Excluded as other areas of utility collaboration are expected yield higher impacts.

A.5.7 On-Bill Repayment or On-Bill Financing Programs

Strategy Description: Develop special financing programs for distributed generation (and energy efficiency) that allow participants to repay costs through a special charge added to their electricity bill. In an on-bill financing (OBF) program, the utility would serve as the financier. In an on-bill repayment (OBR) program, a utility would partner with a third-party lender, and serve as an intermediary. On-bill programs are attractive because they provide new customer options for financing and, depending on the program design, could reduce credit risks and allow lenders to reduce rates or offer loans to additional customers.

Table 49. Policy Detail; On-Bill Repayment/Financing

Topic	Research and Analysis Highlights
Precedent in King County	Both PSE and SCL offer some for form of on-bill repayment. SCL offers OBR for some energy efficiency applications. PSE has proposed using OBR for water heaters, and UTC has previously approved its use for natural gas utilities. Elsewhere in the country (such as in New York State), on-bill programs for rooftop solar are available.
Potential Scale of Impact	**Low** – Additional source of financing expected to have minor impact on overall county power mix.
Cost Effectiveness	**For County: High**; **For Stakeholders: High** - Low cost incurred by County to encourage programs, cost-effective for consumers
Feasibility & Expediency	**Medium** – Simple on-bill repayment of solar may encounter relatively few barriers. However, a program where the utility acted as financier, or that included program design elements suitable to lower credit requirements or interest rates may be more challenging to implement.
Equity Impacts	Potentially positive because can expand financing options to previously excluded parties
Additional Benefits or Costs	
Key Barriers	Potential utility opposition and program design complexity.
Analysis Conclusion	Given the potential to expand rooftop solar access to new markets (including customer that face barriers to financing in current market), on bill repayment/financing is included in the strategy that expands voluntary market participation via utility collaboration.

A.5.8 Establish Formal County-Utility Partnership

Strategy Description: King County and its local utilities would establish a formal collaboration to identify and pursue opportunities of interest, and to serve as the basis for exploring future programs.

Table 50. Policy Detail; Formal City-Utility Partnership

Topic	Research and Analysis Highlights
Precedent in King County	None in King County. Elsewhere, such as Salt Lake City and Minneapolis, city-utility partnerships have been established to jointly pursue opportunities of interest. In Massachusetts, city-utility partnerships on energy efficiency programming have been formalized.
Potential Scale of Impact	**N/A** – This strategy does not lead directly to renewable electricity development in itself, but can be useful in advancing other policies and strategies.
Cost Effectiveness	**For County: High**; **For Stakeholders: High** - There are few costs that will be placed on either the County or utility to form a partnership
Feasibility & Expediency	**Medium-High** – There is likely potential for some form of increased collaboration between King County and its utilities, though it will take time to negotiate the terms of the partnership and develop an implementation plan. Formal and binding agreements may be more onerous.
Equity Impacts	None
Additional Benefits or Costs	
Key Barriers	Negotiating terms of partnership; potential lack of interest from utility.
Analysis Conclusion	Included as a suggested action item for King County, but not included in the scenario analysis given lack of direct impact on electricity mix.

A.6 POLICY DETAIL: PARTNER ON STATE-LEVEL ACTION

A.6.1 Increase Net Energy Metering System Size Limit

Strategy Description: Increase the maximum size limit of Net Energy Metering systems from 100 kW to a higher amount.

Table 51. Policy Detail; Increased Net Energy Metering System Size Limit for Distributed Generation

Topic	Research and Analysis Highlights
Precedent in King County	There is a 100kW limit on NEM system in Washington. Elsewhere, this limit is much higher (such as a 2 MW limit in Oregon).
Potential Scale of Impact	**Low-Medium** - Could dramatically increase the large-scale solar market in Washington. However, any form of customer-owned distributed energy is expected to have a relatively impact on overall power mix.
Cost Effectiveness	**For County: High; For Stakeholders: Medium** - Requires lobbying/convening resources only. Project owners would benefit, but utilities and ratepayers may be negatively impacted by offering full-retail NEM for larger projects.
Feasibility & Expediency	**Low-Medium** – Legislative action required. Unclear how receptive major stakeholders would be to increasing net metering system limits, as opposed to developing successor policies to net energy metering.
Equity Impacts	Neutral.
Additional Benefits or Costs	Local (large scale) electricity production
Key Barriers	Potential opposition from utilities
Analysis Conclusion	Excluded as other state-level policy efforts would offer larger potential impacts.

A.6.2 Increase Net Energy Metering Program Cap

Strategy Description: Raise the NEM program cap from 0.5% of peak sales.

Table 52. Policy Detail; Increased Net Energy Metering Program Cap for Distributed Generation

Topic	Research and Analysis Highlights
Precedent in King County	Washington's NEM program is capped at 0.5% of peak load, though both PSE and SCL have exceeded it and are continuing to accept new applications.
Potential Scale of Impact	**Low** - Would have no immediate impact as utilities have voluntarily exceeded limit, but such a policy step may guard against future restrictions on NEM.
Cost Effectiveness	**For County: High; For Stakeholders: Medium** - No direct costs incurred for County or residents. Would maintain the status quo for other stakeholders.
Feasibility & Expediency	**Low-Medium** – Legislative action required. Unclear how receptive major stakeholders would be to increasing net metering system limits, as opposed to developing successor policies to net energy metering.
Equity Impacts	Neutral.
Additional Benefits or Costs	Local (large scale) electricity production
Key Barriers	Potential opposition from utilities
Analysis Conclusion	Excluded as other state-level policy efforts would offer larger potential impacts.

A.6.3 Allow for Virtual Net Energy Metering

Strategy Description: Allow generation from Net Energy Metering to credit off-site accounts, allowing for an expanded distributed generation market.

Table 53. Policy Detail; Virtual Net Energy Metering for Distributed Generation

Topic	Research and Analysis Highlights
Precedent in King County	Not currently allowed in Washington State.
Potential Scale of Impact	**Low-Medium** - Could expand community shared solar and related practices significantly, though any form of customer-owned distributed energy is expected to have low impact on overall power mix.
Cost Effectiveness	**For County: High**; **For Stakeholders: Medium** - Requires lobbying/convening resources only. Project owners would benefit, but utilities and ratepayers may be negatively impacted by offering full-retail NEM for larger projects.
Feasibility & Expediency	**Low-Medium** – Legislative action required.
Equity Impacts	Depends on program design and market reaction – this could be used as a strategy to target lower income households or to make solar available for renters.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Potential opposition from utilities
Analysis Conclusion	Excluded as other state-level policy efforts would offer larger potential impacts.

A.6.4 Allow Third-Party Ownership of Distributed Generation

Strategy Description: Enact state laws allowing third party-owned distributed electricity projects to receive production incentives.

Table 54. Policy Detail; Third Party Ownership for Distributed Generation

Topic	Research and Analysis Highlights
Precedent in King County	Third-party ownership of distributed generation is permitted in Washington, but as these systems are not eligible for state production incentives there is virtually no third-party market. In other states where third party ownership is fully permitted, it has become a dominant form of solar ownership, allowing customers to avoid the upfront costs of solar.
Potential Scale of Impact	**Low-Medium** – Enabled third party ownership could be particularly impactful for the commercial sector (where solar financing can be complex) and in the municipal/non-profit sector (where customer-owners are unable to claim federal tax credits). It is unclear whether PPA options would be superior to existing lending options, however.
Cost Effectiveness	**For County: High**; **For Stakeholders: Medium-High -** No costs to County in immediate term. Would provide financing option to solar customers, but may not out-perform lending options.
Feasibility & Expediency	**Low** – Legislative action required, and opposition from elements of the state solar industry is likely.
Equity Impacts	Potentially positive in increasing access to distributed generation. If applied in the residential sector, third party ownership could displace local small solar providers.
Additional Benefits or Costs	Local electricity production.
Key Barriers	Political opposition from solar developer community is possible.
Analysis Conclusion	Excluded as other state-level policy efforts would offer larger potential impacts.

A.6.5 Enable PACE financing

Strategy Description: Enact state law allowing community to create special financing districts to fund renewable electricity projects and recover costs through tax bills.

Table 55. Policy Detail; Enable PACE Financing

Topic	Research and Analysis Highlights
Precedent in King County	Previous policy discussions about PACE financing in Washington state have encountered significant legal concerns and the conclusion that a constitutional amendment would be necessary to support enactment.
Potential Scale of Impact	**Low** - Could be helpful in providing improved financing to local projects, but would have limited scale overall as it primarily targets distributed generation.
Cost Effectiveness	**For County: Medium**; **For Stakeholders: Medium-High** – County is prohibited from lending credit, but could assist in facilitation of third party financing. Participating stakeholders would benefit if program provided a low-cost source of financing.
Feasibility & Expediency	**Low** – Thought to require a change in the state constitution.
Equity Impacts	Somewhat positive – PACE can be a helpful tool for residents that own their homes but have difficulty securing adequate financing. But as home equity is required, renters are ineligible to participate.
Additional Benefits or Costs	Local electricity production,
Key Barriers	The need to enact as a state constitutional amendment is a significant hurdle.
Analysis Conclusion	Excluded as other state-level policy efforts would offer larger potential impacts.

A.6.6 Increase State Renewable Portfolio Standard

Strategy Description: Enact a state law increasing utility commitments for renewable electricity purchasing.

Table 56. Policy Detail; Increased State Renewable Portfolio Standard

Topic	Research and Analysis Highlights
Precedent in King County	Washington currently has an RPS of 15% by 2020. This is low and short-term in comparison to leading neighboring states, such as the 50% RPS requirements in Oregon (by 2040) and California (2030). However, the vast majority of Washington's considerable hydroelectric resource does not count towards the RPS.
Potential Scale of Impact	**High** – Would cause broad changes to a utility's resource mix and future plans.
Cost Effectiveness	**For County: High**; **For Stakeholders: Low-Medium -** No direct costs for County; likely to increase supply costs for utilities and/or ratepayers in short and medium term.
Feasibility & Expediency	**Low** – Likely to face complicated political process.
Equity Impacts	Neutral to positive- creates positive impacts for the affected states.
Additional Benefits or Costs	
Key Barriers	Likely opposition from utilities. Several stakeholders expressed concern that attempting changes to the state RPS policy could have unintended consequences, and could have deleterious effects.
Analysis Conclusion	Not included. While an increased RPS could have substantial impact on the state and county power mix, stakeholders felt that there was a less viable pathway to accomplishing this item than other potential state policy initiatives.

A.6.7 Establish a Carbon Price

Strategy Description: Pass state legislation putting a price on carbon

Table 57. Policy Detail; Price on Carbon

Topic	Research and Analysis Highlights
Precedent in King County	Several varying carbon pricing policies have been proposed in Washington in recent years. Proposals have varied in terms of the price that would be placed on carbon, and on how program revenues would be used (some proposals would reduce taxes elsewhere to form a revenue-neutral policy, and others would use these revenues to fund new clean electricity projects). In 2016, I-732, which would have implemented a carbon price, received 41% support as a ballot initiative, and received only mixed support from environmental groups. Governor Inslee has recently proposed a new version of a carbon price for legislative consideration.
Potential Scale of Impact	**High –** Likely to cause broad changes to a utility's resource mix and future plans, based on specific policy details.
Cost Effectiveness	**For County: High**; **For Stakeholders: Low-Medium -** No direct costs for County; likely to increase supply costs for utilities and/or ratepayers in short and medium term.
Feasibility & Expediency	**Medium** – A carbon price is a complex policy proposal with and would require either legislative action or a ballot initiative. However, despite recent failed ballot initiatives, there is considerable political interest in such a policy.
Equity Impacts	Potential to be positive based on the distribution of program revenues. The 2016 I-732 ballot was opposed by some environmental groups due to a lack of an equity focus. As a potential consequence of a carbon price would be the closure of regional coal-fired power plants, coal communities may disproportionately bear an economic burden.
Additional Benefits or Costs	
Key Barriers	Political feasibility and competition of competing proposals.
Analysis Conclusion	Included as a potential high-impact state policy.

A.6.8 State-Level Clean Power Plan

Strategy Description: Pass state legislation adopting the same emissions targets as in the EPA Clean Power Plan.

Table 58. Policy Detail; State-Level Clean Power Plan

Topic	Research and Analysis Highlights
Precedent in King County	The EPA's Clean Power Plan was adopted in 2015, but was but on indefinite hold by the Supreme Court in early 2016. The WA Department of Ecology intends to continue to work with the state's power sector and others, to design the best path forward for all affected. Submission of a final plan to EPA is required by Sept. 6, 2018. Stakeholder in this analysis suggested that state-level compliance with the clean power plan be included in this analysis.
Potential Scale of Impact	**Medium-High –** As the Clean Power Plan would require a reduction in carbon emissions for each state, this could have a considerable impact in Washington. The state's Clean Power Plan must show that the 11 affected power plants in Washington emit at or below the goals by 2030.
Cost Effectiveness	**For County: High; For Stakeholders: Low-Medium -** No direct costs for County; likely to increase supply costs for utilities and/or ratepayers in short and medium term.
Feasibility & Expediency	**Low** – Since the Supreme Court's hold, there has not been significant policy action regarding a state-level approach to these goals, though state targets may be achieved through other state-level policies currently being considered in Washington State.
Equity Impacts	Neutral
Additional Benefits or Costs	
Key Barriers	Without federal requirements for action, there does not appear to be a concerted effort to pursue a state-level clean power plan.
Analysis Conclusion	Excluded as other state policy proposals currently have more political momentum.

A.6.9 Commerce Grants

Strategy Description: Competitive process to fund solar and energy efficiency projects in Washington state. Aim is to fund projects that will improve energy and cost savings in the publicly-built environment.

Table 59. Policy Detail; Commerce Grant Expansion

Topic	Research and Analysis Highlights
Precedent in King County	In the 2015-2017 biennium capital budget, the Department of Commerce received $25 million toward Energy Efficiency and Solar Grants program. The program was put on hold pending the approval of a new capital budget.
Potential Scale of Impact	**Low-Medium –** It is unlikely that the renewable electricity projects that are funded would have a substantial impact on the county power mix, particularly as commerce grants to date have prioritized energy efficiency.
Cost Effectiveness	**For County: High**; **For Stakeholders: Medium –** No cost to County, revenues from state funds.
Feasibility & Expediency	**High** – Appears likely to be funded at some point in future by state.
Equity Impacts	Neutral to positive – depending on specific allocation of funds for projects.
Additional Benefits or Costs	
Key Barriers	Ensuring funding in state capital budget.
Analysis Conclusion	This policy was suggested by stakeholders during the period when the Washington state capital budget had lapsed. As a new budget was signed in January 2018, and because this policy is expected to have minimal impact on the county power mix, it is excluded.

A.6.10 Clean Energy Fund

Strategy Description: The Clean Energy Fund enables projects to support clean energy technology development, demonstration and deployment. Grants are made to organizations for research and development, renewable energy manufacturing, lending by non-profit organizations, and utilities' renewable energy activities.

Table 60. Policy Detail; Clean Energy Fund Expansion

Topic	Research and Analysis Highlights
Precedent in King County	Since 2013, the Clean Energy Fund has provided over $170 million in funding for clean energy project. Funding lapsed after the 2016 allocation, but was refunded in the capital budget passed in 2018.
Potential Scale of Impact	**Low-Medium –** It is unlikely that the renewable energy projects that are funded would have a substantial impact on the county power mix.
Cost Effectiveness	**For County: High**; **For Stakeholders: Medium –** No cost to County, revenues from state funds.
Feasibility & Expediency	**High** – The program has been re-funded in the capital budget passed in January 2018.
Equity Impacts	Neutral to positive – depending on specific allocation of funds for projects.
Additional Benefits or Costs	
Key Barriers	Ensuring funding in state capital budget.
Analysis Conclusion	This policy was suggested by stakeholders during the period when the Washington state capital budget had lapsed. As a new budget was signed in January 2018 that includes new funding, and because this policy is expected to have minimal impact on the county power mix, it is excluded.

A.6.11 100% Renewable New Generation Policy

Strategy Description: A potential policy to require all new utility-scale generation be from renewable resources.

Table 61. Policy Detail; 100% Renewable New Generation Policy

Topic	Research and Analysis Highlights
Precedent in King County	Such a policy is currently being discussed in Washington state, and a proposal (SB 6253) is under consideration by the Senate Ways and Means Committee as of February 2018.
Potential Scale of Impact	**Medium-High** - Would significantly affect utility generation over time over time as fossil fuel generation sources retire, though it would not impact current generating plants.
Cost Effectiveness	**For County: High**; **For Stakeholders: Low-Medium** - No direct costs for County; likely to increase supply costs for utilities and/or ratepayers in short and medium term.
Feasibility & Expediency	**Low-Medium** – As a far-reaching and first-of-its-kind proposal, this policy may face barriers to implementation. However, there is an opportunity for implementation and the policy is current being debated by the Washington senate.
Equity Impacts	Neutral
Additional Benefits or Costs	
Key Barriers	Long time horizon until impacts are visible; political opposition.
Analysis Conclusion	Included as a potential high-impact state policy. Given the uncertainty and novelty of this approach, there may be an opportunity for King County and its associated cities to contribute positively to the policy discussion.

A.6.12 Adjust Utility Procurement Guidance

Strategy Description: Through UTC or legislative efforts, adjust the guidance provided to utilities to incorporate long-term costs including fossil fuels' negative externalities affecting the environment and the community into "least cost" procurement, for example by incorporating a Social Cost of Carbon value.

Table 62. Policy Detail; Adjusted Utility Procurement Guidance

Topic	Research and Analysis Highlights
Precedent in King County	Current UTC guidance is for utilities to procure or develop the "least cost mix of energy supply resources and conservation" in long term planning. This guidance could be adjusted to more firmly clarify how costs should be considered (such as by incorporating a social cost of carbon). Costs of carbon are already considered in some aspects of utility long-term planning.
Potential Scale of Impact	**Medium -** Could shift fuel supply mix for utilities towards more renewables. It is unclear to what degree utility planning and procurement would shift because of this guidance.
Cost Effectiveness	**For County: High; For Stakeholders: Low-Medium -** No direct costs for County; likely to increase supply costs for utilities and/or ratepayers in short and medium term (though the intent of the policy would be to minimize long-term social costs).
Feasibility & Expediency	**Low-Medium** – Timeline for drafting and getting legislation passed may be lengthy, likely to encounter stakeholder resistance.
Equity Impacts	Neutral.
Additional Benefits or Costs	
Key Barriers	Potential resistance from utilities.
Analysis Conclusion	Excluded as other state policies offered a clearer connection between policy action and impact on county power mix.

A.7 POLICY DETAIL: GAIN DIRECT CONTROL OVER POWER MIX

A.7.1 Form a Municipal Utility or Public Utility District

Strategy Description: Acquire utility assets within the county and form a publicly-owned utility, allowing for more County control over generation assets, and potentially allowing preferred purchasing state for BPA generation. This strategy is only applicable to PSE's service territory, as SCL is already a municipal utility.

Table 63. Policy Detail; Municipal Utility

Topic	Research and Analysis Highlights
Precedent in King County	Based on a ballot initiative in 2008, Jefferson County recently formed a Public Utility District and acquired Puget Sound Energy's service area in the county. It is important to emphasize that Jefferson County (population 30,000) is far smaller than King County. Nationally, the effort of Boulder, Colorado to form a municipal utility has been ongoing for nearly a decade and has been costly to the city, though efforts are still ongoing.
Potential Scale of Impact	**High** - Providing County or public utility district with direct control over county utility operations would create new pathways for the county to procure a more renewable power mix.
Cost Effectiveness	**For County: Low; For Stakeholders: Low -** County would face very high capital costs for the acquisition of utility service area, and a new entity would need to be formed to manage the new utility. If done through hostile process, the incumbent utility may receive below market value for operations.
Feasibility & Expediency	**Low** – Formation process would be incredibly difficult and costly, enough to be unviable.
Equity Impacts	Varies, negative if rates increase and disproportionately impact low income families, or positive if public utility uses new powers to pursue equity goals.
Additional Benefits or Costs	
Key Barriers	Not politically viable, would require near impossible political and technical effort.
Analysis Conclusion	Excluded as strategy is not expected to be viable, and it not in line with King County's preferred approach to identify areas for county-utility collaboration.

A.7.2 Community Choice Aggregation Program

Strategy Description: Enact state law allowing local governments to form Community Choice Aggregation programs. In these programs, communities that form CCAs are responsible for procuring power on behalf of businesses and residents, who can opt out of the program. The incumbent utility ceases to be the power provider for CCA customers, though they continue to provide distribution service (similar to a utility in a competitive retail environment).

Table 64. Policy Detail; Community Choice Aggregation Program

Topic	Research and Analysis Highlights
Precedent in King County	None in King County. Nationally, CCAs have been enabled in six states. While most of these states already permit competitive retail supply, California (mostly) does not allow retail choice for most customers and has enabled CCAs, with jurisdictions like San Francisco, Marin County, and San Jose creating CCA programs.
Potential Scale of Impact	**High -** Providing counties with direct control over County electricity purchasing through a CCA would create new pathways for the county to procure a more renewable power mix.
Cost Effectiveness	**For County: Low-Medium; For Stakeholders: Low -** Significant costs to County or other organization in forming and operating CCA; significant decrease in utility revenues from loss of generation sales.
Feasibility & Expediency	**Low** – Requires enabling legislation and formation of a CCA by the County. Would likely be opposed by utility.
Equity Impacts	Varies, negative if rates increase and disproportionately impact low income families, or positive if CCA uses new powers to pursue equity goals.
Additional Benefits or Costs	
Key Barriers	Lack of enabling legislation, long time to implement and political opposition.
Analysis Conclusion	Excluded as strategy is not in line with King County's preferred approach to identify areas for county-utility collaboration, and given degree of difficulty involved in passing state legislation and forming a CCA entity.

A.7.3 Community Empowerment Programs

Strategy Description: A Community Empowerment program would operate on a similar basis as a CCA, but would utilize Virtual PPAs instead of physical power purchases. A community would sign a Virtual PPA on behalf of customers, who would be enrolled in the program on an opt-out basis. Customers would be billed or credited for any charges related to the Virtual PPA as a line item on their utility bill, but would otherwise remain customers of their incumbent utility as normal.

Table 65. Policy Detail; Community Empowerment Program

Topic	Research and Analysis Highlights
Precedent in King County	None in King County. A Community Empowerment program has been proposed in the Massachusetts Senate as an alternative to community choice aggregation, but has not been implemented there or elsewhere.
Potential Scale of Impact	**Medium-High** - County would be able to mimic power purchases, with utility collaboration, up to any desired electricity mix, but would be structured through virtual PPAs.
Cost Effectiveness	**For County: Low-Medium**; **For Stakeholders: Medium** - Significant costs to County or other organization in forming and operating community empowerment program; utility is theoretically cost-neutral minus some administrative costs.
Feasibility & Expediency	**Low** – Requires legislation and significant administrative / power purchasing effort by County. The novelty of the policy creates additional barriers.
Equity Impacts	Neutral.
Additional Benefits or Costs	
Key Barriers	Lack of enabling legislation, complex arrangement that may not satisfy County priorities for renewable electricity development.
Analysis Conclusion	Excluded given the novelty of the policy and King County's stated preference to avoid policies based on Virtual PPAs in meeting renewable electricity targets.

APPENDIX B. MODELING METHODOLOGY

This section outlines the process and assumptions that underpin the quantitative model projections for the baseline and policy scenario impacts.

B.1 DEVELOPMENT OF BASELINE POWER PROJECTIONS

The development of baseline King County power mixes involved five primary analytic steps, conducted separately for SCL and PSE:

1. Forecast of power supply needs through 2030. Cadmus formed a 2016 generation baseline using utility data available through the Washington State Department of Commerce's annual Fuel Mix Disclosure reports.[40] Cadmus used data available from each utility's most recent Integrated Resource Plan (IRP) to forecast an annual increase in supply needs.[41] In the BAU forecast, these forecasts accounted for planned energy efficiency programs. In the worst-case scenario forecast, new energy efficiency impacts were excluded, and additional load from increased electric vehicle penetration was assumed, based on projections in the Northwest Power and Conservation Council's 7th Power Plan.[42]
2. Distributed generation resource projections by year. Current levels of distributed generation resources were obtained from the US Energy Information Administration's (EIA) Form 861 annual utility reporting database.[43] In the BAU baseline, it was assumed that new annual added distributed generation capacity would be equal to the 2016 rate of installations. In the worst-case baseline, it was assumed that there would be no new renewable DG capacity added in future years.
3. Utility owned or contracted generation by year. Taking each utility's 2016 resources as a starting point (sourced from state Fuel Mix Disclosure reports), Cadmus forecasted the amount of long term utility-controlled generation sources available through 2030. In the BAU forecast, this forecast accounted for planned plant retirements and resource additions called for through 2030 (the early Colstrip retirement scenario also assumed the retirement of Colstrip units 3 and 4 in 2027). The worst-case scenario assumed no new fossil fuel plant retirements, and assumed that generation from utility-owned hydroelectric projects would decline slightly over time due to the impacts of climate change, using the worst-case projections from the SCL IRP.
4. Market Purchases. In each year, Cadmus calculated the remaining amount of generation that each utility would need to purchase to meet its annual generation needs (that is, total generation needs minus distributed generation and utility-controlled resources). Cadmus calculated the baseline power mix of these short-term market purchases using the WA Department of Commerce's Fuel Mix Disclosure Reports, which calculate the annual fuel mix of regional short-term purchases and

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[40] Data available at: http://www.commerce.wa.gov/growing-the-economy/energy/fuel-mix-disclosure/
[41] Available at: https://pse.com/aboutpse/energysupply/pages/resource-planning.aspx and http://www.seattle.gov/light/IRP/default.asp
[42] Available at: https://www.nwcouncil.org/energy/powerplan/7/plan/
[43] Available at: https://www.eia.gov/electricity/data/eia861/

applies this on a pro rata basis to each utility's market purchases. Cadmus did not assume any changes in the fuel mix of regional short-term market purchases in the BAU baseline. In the worst-case scenario, Cadmus set the share of hydroelectricity to decline due to the impacts of climate change. These market purchases combine with distributed energy resources and utility-controlled generation to form a projection of each utility's annual power mix through 2030.

5. Voluntary customer purchase projections. Finally, Cadmus calculated the amount of voluntary renewable energy purchased annually by PSE and SCL customers through the SCL Green Up, PSE Green Power, and PSE Green Direct programs. Cadmus assumed that participation in the Green Up and Green Power programs would stay constant in the baseline projection, and that the Green Direct program would expand to meet its current 75 aMW limit by 2030. These voluntary customer purchases were added to the renewable share of each utility's power mix to create a secondary metric of the county's renewable electricity share.

B.2 DEVELOPMENT OF POLICY IMPACTS

For each set of policy actions, Cadmus consulted information from prior programs and the clean energy policy literature to project potential impacts. To determine the impact of each policy and suite of policies on the county's overall power mix, Cadmus adjusted one or several of the five analytic steps discussed above to account for the potential results of each individual policy action.

It should be noted that, for many potential policy approaches, there is significant uncertainty regarding the impacts that would be realized in King County due to sparse prior data, differences in regulatory and market settings between King County and the jurisdictions used as benchmarks, and a generally wide range in the potential impacts of different strategies. While the methodology used in this analysis is appropriate to gauge the general scale of impact that different programs and policies may have in King County, results should be interpreted as having a broad degree of inherent uncertainty.

B.2.1 Package of Standard Local Actions

The impacts of base local policy actions were determined through the following approaches:

1. Permitting best practices, zoning best practices, solar ready guidelines. These three policy actions describe best practices in local solar policy that have historically been described as targeting the soft costs of solar energy, and have been promoted as a set through a series of US Department of Energy SunShot Initiative programs.[44] Cadmus used the results of a Lawrence Berkeley National Laboratory study[45] to estimate the potential price reduction of these solar soft cost programs. Using

[44] Information available at: https://energy.gov/eere/solar/sunshot-initiative

[45] Burkhardt et al. *How Much Do Local Regulations Matter?* (2014). Available at: https://emp.lbl.gov/sites/default/files/lbnl-6807e.pdf

a Yale study[46] of solar energy price elasticity of demand, Cadmus estimated the increase in solar market penetration that would result from these projected price decreases.

2. Solar Mandate. Cadmus assumed that this policy would mirror the approach taken in Seattle, in which new commercial and large multi-family buildings are required to include a minimum of 70W of solar per square foot of conditioned space.[47] As this requirement is already in place in Seattle, it was assumed that the rest of the county would adopt this policy, and that impacts would primarily be in PSE service territory as the policy is already in place in SCL's. New commercial and large multifamily square footage was estimated from the EIA Commercial Building Energy Consumption Survey (CBECS)[48] and Residential Energy Consumption Survey (RECS)[49] databases. It is possible that a number of these buildings would have opted to develop solar in the absence of such a policy, but it was assumed that this impact would be counterbalanced by buildings that opted to develop solar because of the mandate and installed a system that was larger than the minimum system size.
3. Solar at County Buildings. The potential for solar sited at County buildings was estimated using the King County Property Inventory List.[50] The list of 4,370 County-owned parcels included in the inventory was filtered to a set of 317 sites that both have an on-site building (and therefore on-site load) and that had a land use classification that was deemed to be a suitable match for solar (such as building site, maintenance, transit or transfer station, or waste/water pump or treatment facility). Cadmus created a high-level estimate of the potential solar potential at these sites based on assumed square footage and space suitable for solar development, enforcing a maximum system size of 41 kW (the average size of King County's current solar projects). While King County facilities in PSE territory will receive nearly all of their power through the PSE Green Direct program starting in 2019, it was assumed that any on-site generation owned by the County and located in PSE's service territory would create additional Green Direct program capacity that could be subscribed by other PSE customers.
4. Leasing Public Lands for Solar. This policy refers to lease of lands by King County to project developers for larger-scale renewable energy development. Because nearly all of the distributed generation reported by SCL and PSE in the EIA Form 861 database is solar energy, Cadmus assumed that this approach would primarily result in solar projects built up to the current maximum of 100 kW. Using the King County Property Inventory List, Cadmus selected parcels that met the following criteria: no onsite building; a land classification suitable for solar development (such as farmland, gravel pit, or parking lot, or a parcel coded as open space, undeveloped, vacant, or tax title if the parcel is also zoned as rural area, agriculture, or mineral); and adequate land area to support at least a 20 kW solar project, including assumptions about the portion of land area that could be used for solar and a conservative estimate of the percentage of sites that could not be made

[46] Gillingham and Tsventanov, *Hurdles and Steps: Estimating Demand for Solar Photovoltaics* (2017). Available at: http://environment.yale.edu/gillingham/GillinghamTsvetanov_SolarDemandCT.pdf
[47] Information available at: http://www.seattle.gov/DPD/Publications/CAM/Tip422.pdf
[48] Available at: https://www.eia.gov/consumption/commercial/
[49] Available at: https://www.eia.gov/consumption/residential/
[50] Available at: http://www.kingcounty.gov/depts/facilities-management/real-estate-services/property-for-sale.aspx

available for solar due to competing land uses. This selection process resulted in 52 County-owned parcels that were identified as suitable for solar development.

5. Supporting Expanded Solarize Programs. The results of an expanded Solarize program were estimated based on the results of the Solarize Massachusetts program to date, as programs in that state have been supported by state funding and resources. Solarize Massachusetts program results were annualized and pro-rated by population to apply to King County utility service territories.
6. Supporting Community Solar Projects. As the community solar regulations in place in Washington are unlike regulations in other states, potential program impacts cannot easily be determined by benchmarking results of other programs. Instead, it was assumed that County support of community solar projects could result in up to one community solar project per year in each utility's service territory. While this estimate has less precision than those for other policy impacts, County support of community solar is expected to have a *de minimis* impact on the overall county power mix.

All of the above local policy actions would have the result of increasing the rate of distributed generation in King County, and were incorporated in the power projections as an increase in each utility's DG forecast.

B.2.2 Emphasis on Local Action

Under the policy scenario emphasizing local actions, additional impacts were determined as follows:

1. Net Zero Energy Mandate. Based on discussions with King County staff about a potential Net Zero Energy mandate, Cadmus applied the following parameters: following Seattle's current solar mandate and in line with local governments' influence over the commercial building code in Washington, the program would apply only to new commercial and large multifamily buildings; it was assumed that the program would permit some form of off-site generation to be allocated against consumption (removing limitations related to site availability); and it was assumed that building owners would only be required to use new renewable electricity generation to offset the share of their grid power supply that is not already supplied by renewable resources. Cadmus estimated the annual electricity consumption of eligible new buildings in King County using the EIA CBECS, RECS, and Form 861 databases, and assumed that this consumption would be met in a net zero policy through a combination of energy efficiency, wind energy, and solar energy.
2. Local Distributed Generation Incentive Program. Program impacts for a potential local distributed generation incentive were based on the GoSolar San Francisco program, which offers a simple $/W incentive for local solar projects, with special adders for low income customers, residents in designated environmental justice zip codes, and projects using in-city labor. Cadmus annualized the impacts of the GoSolarSF program and pro-rated these to the population of King County. As it can be reasonably assumed that some share of the funding of such a program would be claimed by solar customers that would have installed solar anyways, to account for free-ridership Cadmus estimated program impacts based on the price elasticity of demand of solar. Cadmus assumed that no free-ridership applied in the share of GoSolarSF installations made by low-income customers.

3. Expanded Bioelectric Generation. In this policy approach, King County would prioritize the generation of renewable electricity by repurposing the output from two bioenergy plants, West Treatment Plant and Brightwater Plant, that current sell biogas to gas distributers for thermal use. Cadmus calculated that annual amount of electric generation that could be produced by these facilities, using gas combustion turbine plant heat rate data from EIA.

All of these independent local policy actions would result in an increased rate of distributed generation in King County, and were incorporated in the power projections as an increase in each utility's DG forecast.

B.2.3 Maximize Voluntary Renewable Electricity Purchases

The potential impact of voluntary customer actions was determined as follows:

1. On-Bill Repayment or Financing. The impacts of an OBF or OBR program are assumed to result from broader accessibility to clean energy finance, which would allow more utility customers to take advantage of existing opportunities to purchase distributed renewable energy systems. As a review of OBF literature did not yield a reliable study of the impacts of an OBF or OBR program on distributed generation specifically, impacts were estimated using a peer-reviewed and published study of the net program impacts of PACE financing.[51] Due to the similarities of PACE and on-bill programs from the customer perspective, it was assumed that an OBF or OBR program impact would be similar to that of a PACE program.
2. Green Power Program Expansion. Cadmus referenced data from a NREL study on utility green pricing programs[52] to determine the potential maximum impact of SCL and PSE's REC-based programs. As of the end of 2016, the most-subscribed utility green pricing program was that of Portland General Electric, whose Green Source program enrolled 16.9% of eligible customers. In comparison, PSE and SCL green pricing programs currently enroll between 3% and 4% of customers. It was assumed that PGE's enrollment level provided the upper bound of potential participation in green pricing programs in King County (this estimate was also generally in line with potential subscription goals quoted by PSE staff in project interviews). Cadmus assumed linear annual growth in PSE and SCL green pricing programs with a target of meeting this participation rate in 2030.
3. Green Direct Program Expansion. In the baseline model, Cadmus assumes that the PSE Green Direct program will expand to fully subscribe the 75 aMW amount that is currently authorized by state regulators. In this policy scenario, Cadmus envisions a potential increase beyond this 75 aMW program amount. Currently, PSE's Green Direct program is limited to large customers that can purchase at least 1 GWh per year through the program, and stakeholder interviews indicated that this program would likely be reserved for large power consumers in the future. Therefore, Cadmus

[51] Ameli et al., *Can the US keep the PACE? A natural experiment in accelerating the growth of solar electricity*. (2017). Available at: https://rael.berkeley.edu/wp-content/uploads/2017/02/Ameli-Pisu-Kammen-PACE-Applied-Energy-2017.pdf

[52] Available at: https://www.nrel.gov/analysis/assets/pdfs/utility-green-power-rankings.pdf

estimated maximum large commercial sector participation by sourcing annual PSE commercial and industrial sector sales from the EIA Form 861 annual reporting database, pro-rating these sales to the King County area, and estimating the share of C&I sector sales that were made to large businesses that could be eligible for the PSE Green Direct program. For the latter step, Cadmus used data from the US Census Bureau's Statistics of US Businesses (SUSB) to allocate commercial energy consumption in Washington state to large and small consumers, based on firm employment figures (in-state employment of 100 was used as a cutoff for an eligible commercial entity). As green tariff programs such as Green Direct are relatively new and limited program data is available, Cadmus assumed the upper bound of potential participation to be the same PGE green pricing participation rate of 16.9%. This approach yielded a total potential program size of 149 aMW for the Green Direct program, or roughly double the current allowable program size. Cadmus applied a linear growth factor to PSE's Green Direct program to achieve this level by 2030. It was assumed that this program would only occur in PSE service territory and that SCL would not offer a comparable program.

4. Opt-Out Green Direct Program (scenario variant). Based on stakeholder interest, the Project Team conducted an additional scenario that evaluated the potential impacts of a Green Direct or similar voluntary renewable purchasing program that was implemented county-wide for all customer classes on an opt-out basis. While the path to implementation of such a program is unclear and may not be feasible in practice, it provides a useful reference point as the theoretical maximum renewable electricity penetration possible with voluntary electricity purchases. As an opt-out Green Direct tariff would operate in a similar manner as a Community Choice Aggregation (CCA) program, Cadmus consulted the planned and actual opt-out rates from CCA programs and selected a 20% opt-out rate. This opt out rate is on the high end of the actual experience of many CCA programs, but was selected here as it was assumed that such a program would require customers to pay a premium on the retail price of electricity to obtain 100% renewable electricity through a Green Direct program, whereas the base offer of many CCA programs is a price decrease compared to incumbent utility rates. Therefore, it was expected that the opt-out rate for this program would be higher than that of an average CCA program.

In this policy scenario, the impacts of an on-bill repayment or financing program were incorporated into the DG forecast of each utility. The impacts of Green Power and Green Direct programs were incorporated into the forecast of REC sales (while the Green Direct program may be better described as a utility-owned source of power, it was treated as a REC-based program so that all utility green pricing programs would be incorporated into the power forecast together).

B.2.4 State Policy Actions

The impact of the two state policy actions modeled in this analysis were determined as follows:

Carbon Pricing Policy

There are several recent or active carbon pricing proposals for Washington State, with two of the key differentiating factors being the price placed on carbon (with first-year values ranging from $15 to $25 per ton and escalating thereafter[53]), and whether a carbon pricing scheme would be designed to be revenue-neutral or to generate revenue for clean energy projects.

Cadmus based its assessment of the impacts of a carbon pricing scheme on a recently completed Energy+Environmental Economics (E3) study commissioned by the Public Generating Pool (PGP),[54] a group of public utilities in Washington and Oregon, which evaluates both a $15/ton and $25/ton carbon price. In either case, the primary impact of the carbon price was determined to be a decrease in regional coal generation of more than 99% by 2030. Through 2030, this decrease in coal generation is primarily made up for through a decrease in electricity exports out of the northwest (both Washington and the region are net electricity exporters), with some moderate increases in natural gas and solar generation projected as well. By 2050, E3 projects significant amounts of wind to be added to the regional grid compared to the baseline as carbon prices continue to rise. The E3 analysis shows minimal difference in the impact of the $15/ton and the $25/ton carbon price in the regional projected power mix.

To assess the impact of a carbon price on King County, Cadmus modeled a linear decline in the share of coal generation in the northwest through 2030 in line with E3's projections, as well as the less impactful changes to renewable energy and natural gas generation. Following E3's analysis, Cadmus assumes that, while the share of coal in the northwest power market will decrease, this will primarily have the result of reducing electricity exports from the northwest. Therefore, Cadmus assumed that any market purchase needs of King County utilities would be met using this adjusted blend of northwest energy generation. E3 projects a significant amount of new wind and solar to be added to the northwest power mix because of the carbon price, but as this is not projected to occur until after 2030 this impact is not included in this analysis. These impacts were reflected both in the forecast of utility owned generation and in the forecast of the regional power mix from market purchases.

Different carbon pricing proposals have suggested different uses of program revenues. Some proposals are designed to be revenue-neutral, by reducing taxes elsewhere to account for increased taxes from a carbon pricing program. Other proposals would use carbon revenues to fund new projects and programs, potentially including new clean energy projects. While the latter approach, if adopted, may result in some increased amount of new renewable electricity generation in King County, this analysis conservatively assumes to no such program would be put in place so as not to overstate the expected impacts of a program.

100% Renewable New Generation Policy

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[53] The $25/ton carbon price is escalated at 3.5%/year plus inflation, and the $15/ton proposal is escalated at 5.5%/year plus inflation. (These continue to move around – may want to caveat "rates at time of writing".

[54] Available at: http://www.publicgeneratingpool.com/e3-carbon-study/

Cadmus used two approaches to estimate the impact of a 100% Renewable New Generation policy – one based on impacts forecasted using utility IRPs and the E3 PGP study, and one based on a potential accelerated schedule of power plant depreciation and retirement based on discussions with project stakeholders.

In the first variant, a policy banning new fossil fuel generation would have minimal impact on the grid power mix. To meet future demand needs, the PSE IRP calls for the development of roughly 1,200 MW of thermal peaking capacity (assumed to be a mix of oil and natural gas), which are included in the baseline models but are excluded from this scenario. However, as this new capacity would be used for peaking purposes and not baseload power, its addition or exclusion has a relatively minimal impact on PSE's annual power mix. SCL's IRP does not call for any new thermal energy development.

E3's regional PGP study also evaluates the impact of a 100% Renewable New Generation ("No New Gas") policy, and finds that in the reference baseline, a significant amount of new natural gas would be developed for peaking purposes by 2030, but minimal new baseload gas is projected. In a 100% Renewable New Generation scenario, the primary impact of this policy projected by E3 is to replace new natural gas capacity with energy storage, which would cause a significant change in the breakdown of installed capacity in the northwest, but only a minor change in the annual power mix. As with the carbon price scenario, Cadmus uses the projected changes in the regional power mix from the E3 study as the basis for an adjustment in the mix of regional market power, modeling a slight decrease in natural gas generation and a slight increase in solar generation (based on the E3 study results) in addition to the exclusion of the additional peaking thermal plants called for in the PSE IRP.

The second variant of the 100% Renewable New Generation policy evaluates the impact of natural gas plant retirements, if they were to occur before 2030. While PSE's IRP does not call for the retirement of any natural gas plants (the projected retirement of coal-fired power plants in the PSE IRP are already included in the model baseline), stakeholders have noted that these retirements may occur upon the full depreciation of PSE natural gas assets. Stakeholders identified 508 MW of PSE natural gas baseload generation from the Fredonia, Frederickson, and Encogen plants that may be fully depreciated by 2030, and which could potentially be retired (and not replaced by new natural gas assets under the 100% Renewable New Generation policy). PSE's 2016 Depreciation Study, conducted by Gannett Fleming,[55] agreed that the Frederickson and Fredonia plants had likely retirement dates in 2030, but projected a 2033 retirement date for the Encogen plant. This analysis does not make a claim as to the likely retirement date of PSE's natural gas fleet, but adopts the more aggressive estimates of depreciation and retirement of the natural gas plants as the basis for this second model variant, to effectively bound the potential impacts of

[55] Available at: https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=242&year=2017&docketNumber=170034

this policy. This model variant assumed that these three natural gas plants (as well as Colstrip units 3 and 4) would be retired by 2030 and replaced with additional market purchases.

In addition to modeling the retirement of utility-owned fossil fuel generation and the avoidance of new thermal capacity, this modeling scenario adjusted the future mix of power sources in the regional grid to match the outcomes of E3's analysis.